RUN®

The Commodore 64 & VIC-20 Magazine

PREMIERE ISSUE

USA $2.95
January 1984
A Wayne Green Publication

Arcade Challenge—
Ordeal in the Canyons of Zelaz

Close Encounters with C-64 Word Processing

VIC's Video Flash Cards

Fun Action Games:

Sea Battle
Target Shoot
Symbol Code

Free—$20 VIC Disk Program

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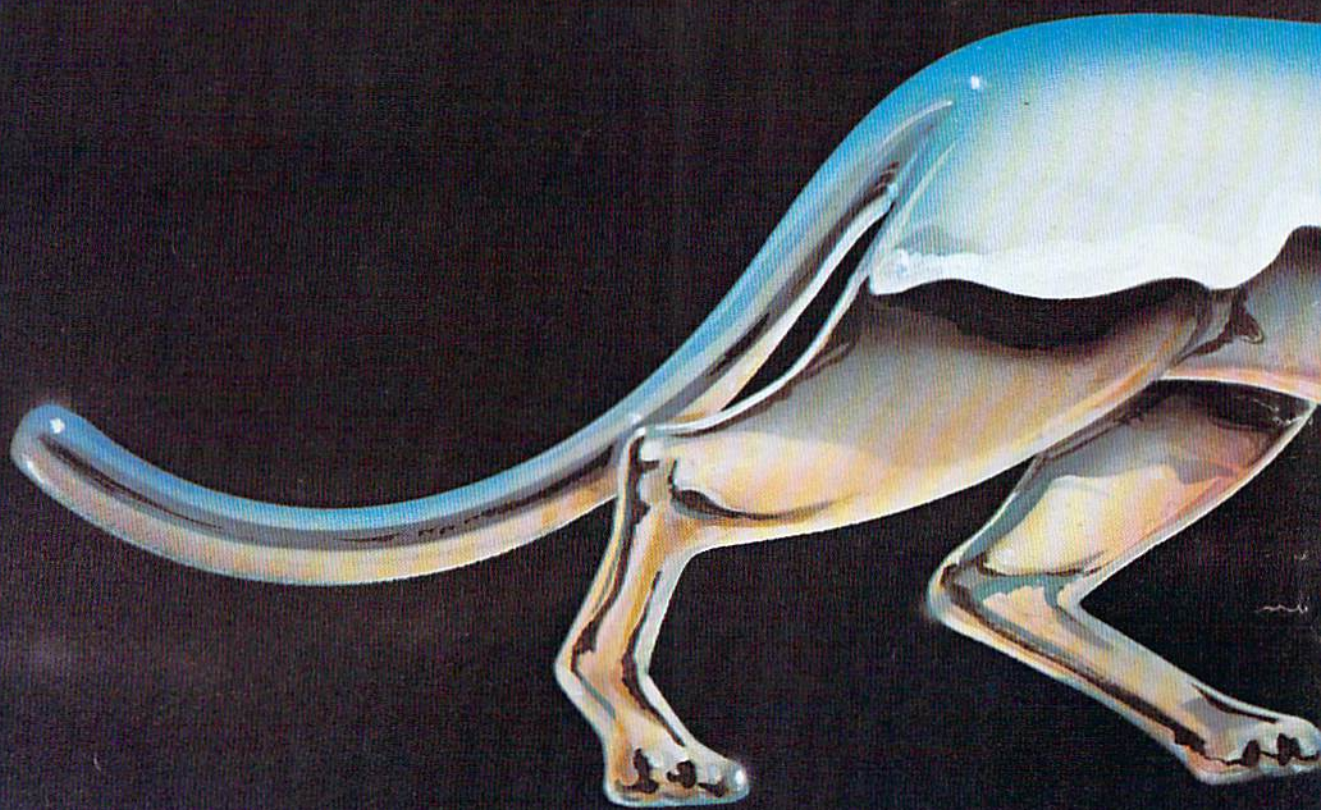

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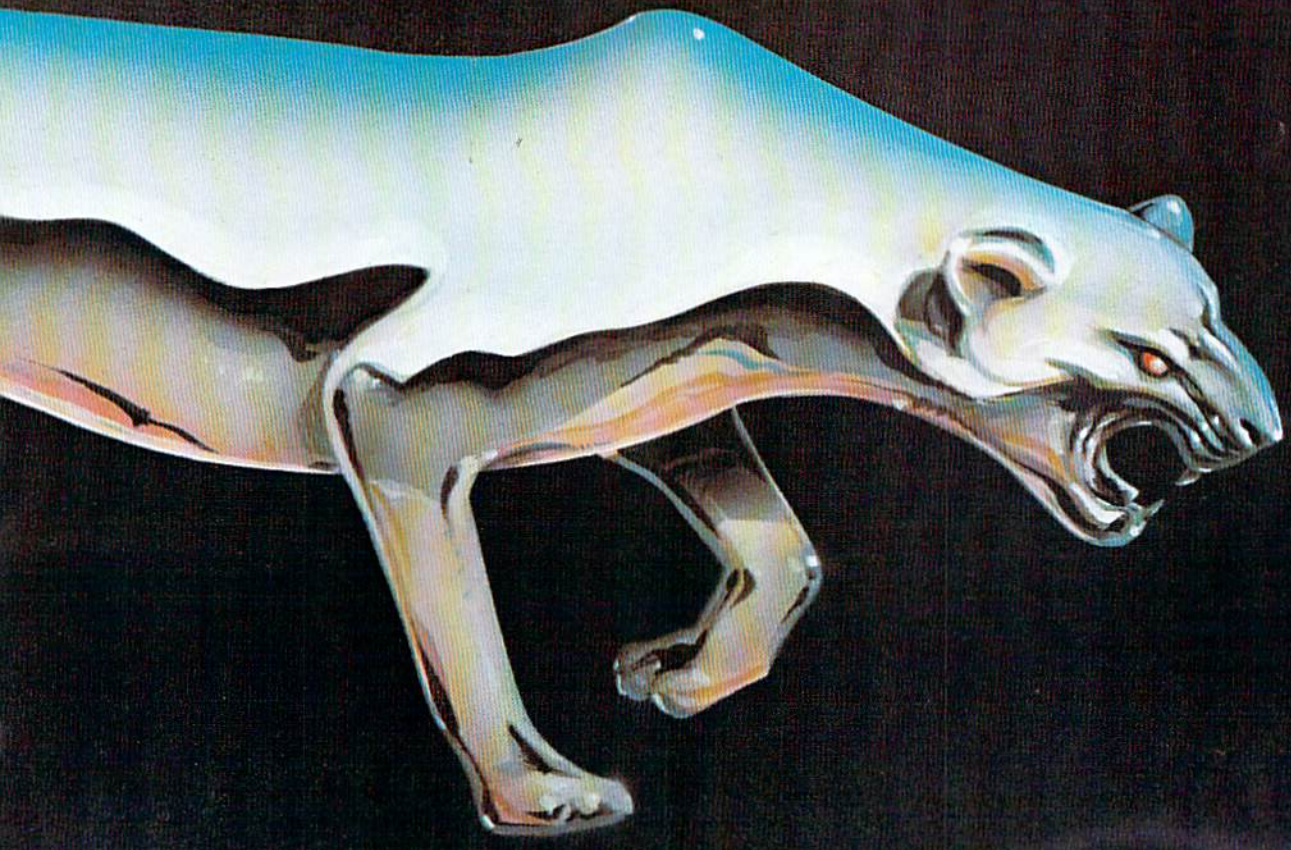

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Premiere Issue

WAYNE GREEN INC.

RUN

PETERBOROUGH, NEW HAMPSHIRE 03458 USA

Dear Reader,

Yes, I can hear it now—"Good grief, still another computer magazine!" Yep, and I think you'll agree that this one is good news.

A system-specific magazine is particularly valuable both for the user of the system and the manufacturer. It helps the users get in touch with each other and pass along what they've learned.

And it provides a forum for manufacturers (and potential manufacturers) of hardware add-ons and software to market their products. For instance, one of my magazines, *80 Micro* for the Tandy TRS-80, is credited with generating a more than $20-million-a-month business that just didn't exist before the magazine made it possible.

The Commodore VIC-20 and 64 systems, for all their spectacular sales, have been seriously hindered by the lack of a dedicated, believable magazine.

The climate now seems conducive to doing a Commodore magazine, so here we are—still in time to start making things happen with 20 and 64 support. With the price of the 64 coming down into the old VIC range, a lot more computing power is available for your money. Indeed, the 64 has to be one of the best buys in computer power on the market.

With *RUN* to help you get the most out of your 20 or 64, I hope that you have as much fun with your computer as we have in publishing this magazine for you. You'll be reading articles on new gadgets and programs for your system, ways to get more out of it and ways to learn more yourself so you can program and modify existing programs.

RUN promises to do for Commodore owners what my other system-specific magazines—*80 Micro*, *inCider* and *HOT CoCo*—have done for TRS-80, Apple and Color Computer users. Who knows, given Commodore's status as the most popular home computer, *RUN* may eclipse my other magazines in a very short time.

Whether you're a beginner or a more advanced Commodorist, I guarantee you'll have more fun with your system if you read *RUN* every month.

I hope that you enjoy *RUN*. If you have any ideas for improving it, please let me know.

Sincerely,

Wayne Green

Wayne Green, Publisher

73 MAGAZINE
MICROCOMPUTING
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DESKTOP COMPUTING
INCIDER
HOT COCO
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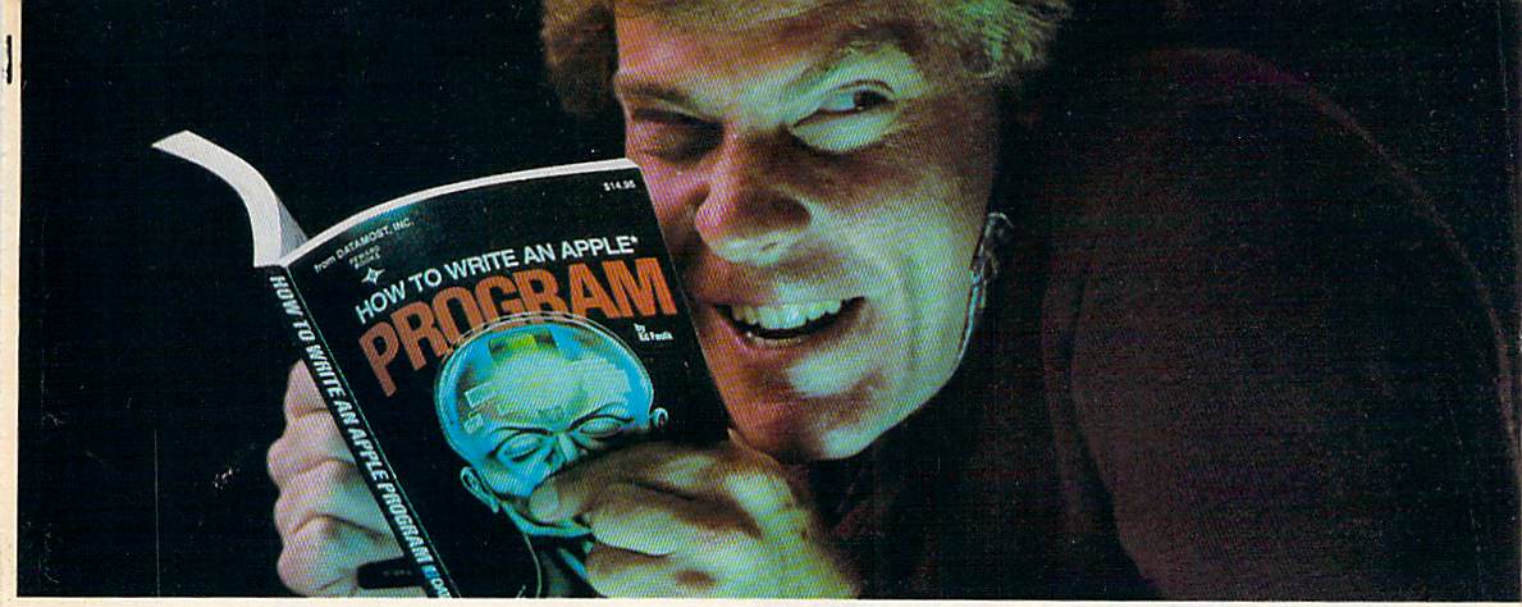

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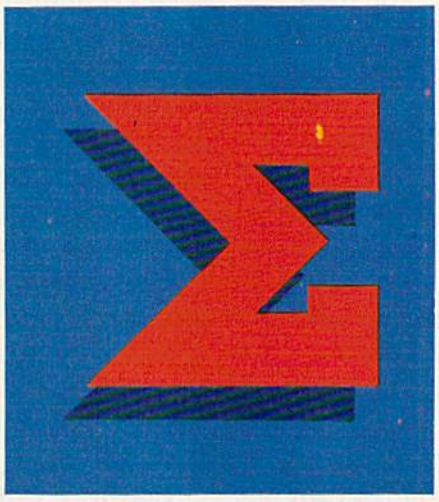

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RUNning Ruminations

Welcome to the World of *RUN*

What's in a Name?

After many weeks of deliberation, we chose *RUN* as the name for this magazine from a long list of alternatives. I think it's a perfectly good title for a magazine about the VIC-20 and Commodore 64.

It's catchy and easy to remember. And any microcomputer enthusiast worth his joystick is familiar with Basic's RUN command, which is used to begin program execution.

However, we hope the title doesn't lead to confusion among the joggers in the audience. There are already several good magazines on the market that address the sport of running. And quite frankly, we don't plan to compete. So don't look for any articles on how to train for your next marathon.

What you will find in each issue of *RUN* are articles to get you and your Commodore system in shape for maximum enjoyment and productivity.

With this first issue, we're off to a good start. In fact, you could say we're off to a RUNning start.

How to Use This Magazine

RUN Magazine is written, edited and designed with you, the VIC-20 and Commodore 64 user, in mind. Each issue is filled with reviews, games, applications, programs, tutorials, hints and modifications to help new owners get started and advanced users get the most out of their systems.

Some of the articles are written by the editorial and technical staffs of *RUN*. Others come from well-known writers and authorities in the Commodore field (such as *RUN* associate editors Robert Baker, David Busch, Louis Sander and Jim Strasma).

But much of what we print comes from you, the Commodore computing enthusiast who wants to share his experiences and pass along computing tips, programs or applications to the Commodore community.

We want your articles and ideas! Your favorite programming technique or clever solution to a particular computing problem may be exactly what thousands of other readers are looking for. Let us decide. Send for the *RUN* author's guidelines.

With a burgeoning support industry sprouting so many hardware and software products for the 64 and the VIC-20, how can you possibly keep track of what's new and available? Simple...rely on *RUN*, which is committed to keeping you informed and up-to-date.

RUN's reviews and product news will help you make intelligent decisions regarding future purchases for your system—whether you're in the market for a word processor for your VIC-20, a disk drive system for your Commodore 64 or perhaps one of those new low-cost printers you've been hearing about. Referring to *RUN before* you buy can save you many times the cost of your subscription.

Starting with this first issue, *RUN* will be full of programs that you can type into your computer and use. And we're making a special effort to produce program listings that are as easy to enter as possible.

We publish Basic listings in an easy-to-read size, produced on a letter-quality printer. And you'll notice that our

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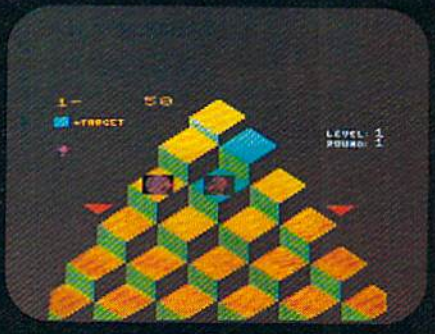

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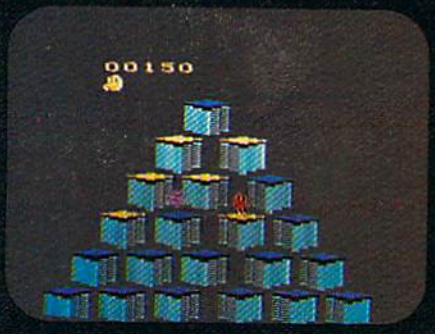

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COMMODORE 64

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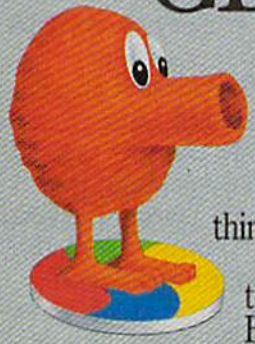
HOW TO GET Q*BERT™ OUT OF YOUR SYSTEM.



If you've been wanting to play Q*bert, but haven't been able to find it available for your home system, your time has come. Because now you can keep things hopping with any of these popular home video and computer formats.

Get going to your nearest video store and get Q*bert today. And while you're there, check out Parker Brothers' POPEYE,® FROGGER,™ TUTANKHAM,™ and SUPER COBRA.™ All the great Arcade Action® games, now in all the great home formats.

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listings contain no unreadable graphics characters. They're virtually hassle-free.

Whenever a special character is needed, you'll find in the listing a pair of brackets containing instructions on exactly which keys to press. There are neither charts to memorize nor special codes to learn. Just follow the instructions within the brackets.

Another feature to look for is the *RUN* It Right box, which appears with each article containing a program listing. This box contains the system requirements—the memory capacity and hardware—to run the program.

You will soon become familiar with the *RUN* monthly columns, such as Commodore Clinic (questions and answers to computing problems), Magic (tips and hints to help you make better use of your VIC-20 or C-64) and Video Casino (original games for you to type in). And be on the lookout for our contests!

This is your magazine. Make the most of it. If you have any article ideas or suggestions for improving the magazine, please drop us a line. By keeping open the lines of communication, we can produce a better and more useful magazine, which is what we all want.

RUNning Ahead of Schedule

You remember the old good news/bad news routine, right?

Well, I've got some great news and some not-so-great news for you.

You're holding the great news in your hands right now—the premiere issue of *RUN Magazine*, about which we are pleased, and hope you will be too.

The not-so-great news is that this issue will have to tide you over until the middle of January.

"What?" you're probably saying, "I thought it was supposed to be a monthly magazine."

Well it is, but let me explain.

You see, subscribers were originally to receive copies of the first issue on or around December 15. However, riding on a wave of enthusiasm generated by staff, advertisers and subscribers, we found ourselves way ahead of schedule. So we decided to hustle this magazine into print in time for Thanksgiving. (I think the early production schedules had something to do with it too.)

We will adhere to the regular schedule with the next (February) issue, which subscribers will receive after the Christmas holidays, on or about January 15.

Look upon the seven-week period between the first and second issues as an opportunity to carefully savor each tender tidbit of information packed into this first issue. It will stay with you long after the turkey drumstick has been picked clean.

Happy holidays and happy computing.

db

Notice to Subscribers

This premiere issue of *RUN Magazine* is being mailed to you three weeks early to accommodate printing schedules. Hereafter, you can expect to receive your monthly copy of *RUN* around the middle of the month preceding the cover date. For example, you will receive the next (February) issue of *RUN* in mid-January.

How to type listings from RUN Magazine

Typing in listings can be difficult enough without having to worry about strange graphics characters, charts or tables. That's why we decided to make it easy to enter listings from RUN by translating everything we thought might be confusing in any program.

When you see something in brackets, all you have to do is press the keys indicated. For example:

[SHIFT L]—means hold down the shift key and press the L key at the same time.

[COMD J]—means hold down the Commodore key (it is on the lower left side of the keyboard) and press the J key at the same time.

[SHIFT CLR]—hold down the shift key and press the CLR/HOME key.

[HOME]—press the CLR/HOME key without shifting.

[CTRL 6]—hold down the control key and press the 6 key.

[FUNCT 2]—function 2 (in this case, you hold down the shift key and press the function 1 key).

[CRSR UP] [CRSR DN] [CRSR LF] [CRSR RT]—these are the four cursor directions.

[UP ARROW]—means the arrow key (the one with the pi sign under it).

[POUND]—the British pound sign (£).

[PI]—the pi sign key (π); (shift and press the up arrow key).

In some instances, when a large number of characters or spaces are repeated in a listing, we will represent them this way: [22 spaces] or [17 CRSR LFs].

We hope this system will make it easier to enter the listings without having to remember or refer to any charts or conventions. If you have any suggestions as to how we might improve the system to make it even easier, drop us a letter.

Attention, Shoppers

Are you in the market for new software, hardware or accessories for your system? Well, be sure to take advantage of the unique free service that RUN Magazine offers in each issue.

Each advertisement in the magazine, as well as each new product and software announcement, is assigned a Reader's Service number, which corresponds to numbers on the Reader Service card in the back of the magazine.

For more information about a particular product, just mark the appropriate number on the Reader Service card and drop it into the mail. In a short time you will receive literature from the advertiser about his product.

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Magic

We've summoned the mightiest spirits in the computing world to bring you this grab bag of useful hints, tips and techniques. These magical delights are designed to enchant you with wonderful ways to make the most out of your system. If you have conjured up any tricks of your own, send them in to this column.

Compiled by Louis F. Sander

MAGIC is tricks, MAGIC is fun.
MAGIC is doing what cannot be done.

MAGIC is a monthly column of hints, tricks and odds and ends from the worlds of software, hardware and applications.

Every month, MAGIC brings you brief and useful computer tricks from around the world—tricks that others have found to make computing easier, more enjoyable or more exciting.

MAGIC features simple hardware ideas, one-line programs, useful subroutines, little-known computer facts and similar items of interest. We look for new or recycled material that is of current value to Commodore computerists and that can be implemented with a minimum of time, effort or theoretical knowledge.

MAGIC is your best and most complete source of pointers in practical computing, and is an international forum for sharing tricks with other computerists. Send your own tricks to:

MAGIC
c/o Louis F. Sander
PO Box 15253
Pittsburgh, PA 15237
U.S.A.

RUN *will pay $20 to $50 for each trick we print.*

Note: MAGIC's tricks are numbered in hexadecimal for your edification.

Trick $00. This month's "one line special" is an antiquity—from the far-off days of 1978, when an 8K Commodore PET cost $795, and readable documentation was unheard of. There weren't any books, and the only magazines were newsletters produced by amateurs.

The PET Gazette was one of them, and here is one of its early offerings, called "BURROW":

```
1A$="[up][down][left][right]":PRINTMID$(A$,RND(.5)*4+1,1)
"*[left]";:FORI=1TO30:NEXT:PRINT"[rvs on][space][left]";:GOTO1
```

It fits on one 40-column line, and it *does* get exciting.

We'd like to see *your* one-line programs, and we want to print at least one good one each month. Programs can be fun, funny, useful or useless, as long as they fit in 40 columns or less. What do you have?

* * *

Trick $01. You can fit lots of statements onto one program line by using the abbreviations for Basic keywords from the appendix of your user's manual. When the line is listed, the keywords are printed out in full, so your program line might take up more than the usual number of screen lines.

This is no problem, but if you try to edit the long line, your computer will cut it down to normal program line size. So use abbreviations to pack the statements into a line, but be *very* careful when editing it later.

Pittsburgh Commodore Group Newsletter

* * *

Trick $02. All 16 Commodore 64 colors can be called up from the keyboard, but only eight of them are marked on the keys. If you put a 6-inch piece of masking tape above the number keys 1–8, you can mark it with the other colors to make your life easier.

The colors are called by pressing the Commodore Logo key simultaneously with a number key. From left to right, they are orange, brown, light red, dark gray, medium gray, light green, light blue and light gray.

L.F.S.

* * *

Trick $03. On some TV sets, the VIC's screen display may not be centered quite right, resulting in a cut-off picture. Location 36864 controls the horizontal center of the screen (normally 5), and location 36865 controls the vertical center of the screen (normally 25). Changing these values can help you to properly center your display.

Westmoreland Commodore Newsletter

* * *

Trick $04. The so-called "quote mode" can be maddening when your computer is in it, and *you* want to be out of it. You can usually get out of quote mode by typing another quotation mark, then deleting it.

But sometimes that doesn't work, such as when you're filling in the spaces opened up by the insert key. Those spaces behave as though the quote mode were active, even when it isn't, and typing another quote won't change anything. If you press any cursor control key when you're on an inserted space, you invariably get the quote mode version of that cursor control, which is often not what you want. When you try to delete it, you get the reverse field T instead, which of course puts you deeper into trouble.

The solution? Press shifted return, which moves the cursor to the next line without "entering" the line you are changing. It also kills the quote mode on the inserted spaces, so you can put your cursor back up there and do whatever you please.

Tom Fetherston

* * *

Trick $05. The mathematical expression between If and Then determines whether the rest of an If statement will be executed. When the expression is false, the rest of the line is skipped.

You can use this feature to save execution time. Rather than using a statement like 100 IF X=1 AND Y=2 THEN PRINT Z, it is much faster to write 100 IF X=1 THEN IF Y=2 THEN PRINT Z.

In the first case, X=1 AND Y=2 must be evaluated before any line skip decision is made. In the second, as soon as X=1 is evaluated as false, everything else is skipped. The result is faster execution whenever X=1 is false.

Bob McKinley

* * *

Trick $06. Here's how you can time the execution of two similar pieces of code:

```
100 TI$="000000"
110 FOR I=1 TO 500
120 Code to be tested goes here.
130 Etc.
140 Etc.
180 NEXT
190 PRINT TI
```

Run the program with one version of your code, and note the value of TI, which is the number of jiffies it took to execute 500 times. Then replace your test code with the other version and run the program again. The version taking fewer jiffies is faster.

L.F.S.

* * *

Trick $07. When checking FRE(0) on the Commodore 64, you often get a negative number. (It doesn't mean you have negative available memory; it has to do with the way FRE represents numbers.) To convert the negative value to its proper form, do this:

```
PRINT FRE(0)+2[up arrow]16
```

Also, there's nothing magic about the zero in FRE(0); you can put *any* letter or number in there. It's usually easier to find FRE(9) on the keyboard, and it gives the same result.

Eric Haver

* * *

Trick $08. Use strips of Scotch Magic Tape to label your cassettes; they take pencil marks very well and can be easily

erased. But be careful to keep the eraser crumbs out of the tape and the tape deck.

L.F.S.

* * *

Trick $09. Store your program tapes in Radio Shack # 44-608 soft plastic cassette mailers. They are tougher and less expensive than the hard plastic boxes.

Hashafisti Scratchi

* * *

Trick $0A. Want to get your hands on a good computer book? Go to your local public library and talk to the people in charge. They *might* have just the one you're looking for. If they don't, they will welcome your suggestions.

If you get lucky, they'll enlist you as an unpaid computer book consultant, letting you help them by telling them what books to buy. They'll help *you* by taking your advice, which makes a lot of good reading material available to you.

By the way, be sure they know about the computer magazines that interest you—especially the new ones!

Mary Lee Resnick

* * *

Trick $0B. Want a very readable, very comprehensive guide to the world of computers? Want to learn about big systems as well as micros? If so, invest $3.95 in Radio Shack's *Understanding Computer Science*. It's a tutorial on the big picture of computers in our world, and it's sure to add to your stock of useful knowledge.

L.F.S.

* * *

Trick $0C. When saving a program on tape, add the RVS to your program name. Then when you read it back, it will print the name on a white background, making it easy to spot. Just type SAVE "[rvs on] PROGRAM NAME [rvs off]" [return].

The PET Gazette

* * *

Trick $0D. If you have a program in memory and want to run it, you don't have to type the word RUN. Just type in any letter or letters (not numbers), then hit the shifted run/stop key. Your program will run for you.

The PET Gazette

* * *

Trick $0E. If you have poked out the write-protect tab on a cassette, there are two ways you can override the protection. One is to put tape over the hole that you punched out. The other is to fool your Datassette into thinking the hole has been covered.

Open the Datassette cover and locate the small pin that fits into the empty hole. (It's way in the back, far to the left.) Then gently push the pin toward the back of the recorder and press the record button. Insert your tape and hold the record button down again as you press the play button.

The PET Gazette

* * *

Trick $0F. You don't need to put parentheses around the number after a SYS statement. SYS828, SYS 828 and SYS(828) all mean the same thing to your computer.

L.F.S.

* * *

Trick $10. Trying to put graphics or shifted letters into REM statements can be frustrating—they list in strange ways, usually as Basic keywords. To get them to behave, put them inside quotes.

The Transactor

* * *

Trick $11. A fast way to tell if an integer is even or odd is to AND it with 1. If the result is zero, the integer is even; if the result is one, the number is odd. For the trick to work, your number must be in the range – 32768 to + 32767; otherwise you will get an illegal quantity error.

Westmoreland Commodore Newsletter

Circle 204 on Reader Service card.

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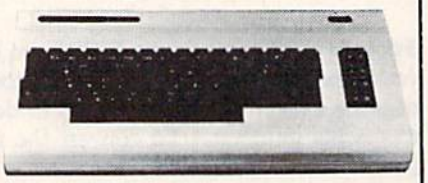

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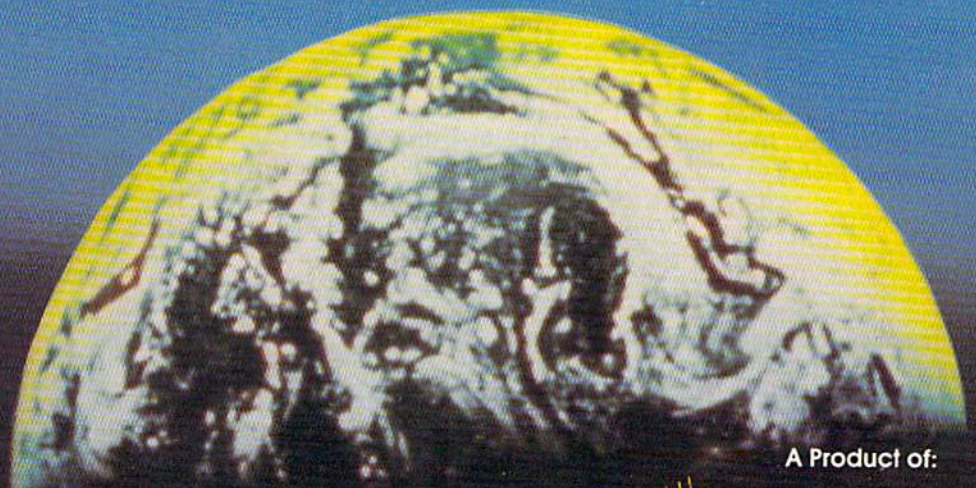

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Commodore Clinic

By Jim Strasma

Commodore Clinic will be a regular monthly column designed to help you, the RUN *reader, through any troubles or questions you have as you use your new VIC-20 or C-64 computer.*

Our columnist, Rev. Jim Strasma, is well-known in the Commodore world. With his wife, Ellen, he has written five books about Commodore computers, and they also edit the Midnite/ PAPER, *a small magazine specializing in brief reviews and hints about Commodore systems.*

Jim's experience with Commodore machines dates back to 1977, when the first PET was introduced, and covers every model since. Although primarily interested in software, he also dabbles in hardware and is qualified to service Commodore computers.

This column is designed to bring answers to your questions. If the first answer isn't the whole story, other RUN *readers may be able to improve on it. So send your questions to:*

Jim Strasma
1238 Richland Ave.
Lincoln, IL 62656.
U.S.A.

(If you include a stamped, self-addressed reply envelope, you will also receive a personal reply.)

* * *

Are there any public domain or tradable programs for preschoolers who cannot read, for either the VIC-20 or C-64? My five-year-old daughter finally took an interest in my machines. The only programs that I have been able to find for her are a simple one called How Many? and a joystick tester that prints out in colors.

Herb Gross
Elgin, IL

There are now three good commercial programs available for your kindergartener. Each uses an easy picture or number menu. She can then choose from up to a dozen short, colorful educational programs.

Our favorite is Kinder Koncepts (Midwest Software, Farmington MI). Next is Kindercomp (Spinnaker, Cambridge MA), and then Early Games for Young Children (Counterpoint Software).

As for public domain equivalents, you've now received some we had for the PET. After you convert them to the C-64, let us know, so other *RUN* readers can enjoy them too.

* * *

Should the program 1541 Backup take at least a half hour to copy a full disk? Also, using two 1541 disk drives, Copy-all took five hours to copy four disks, and even then it started reporting errors about halfway through. When will Commodore make a disk drive with acceptable speed?

Connie Archambault
Meriden, CT

Yes, 1541 Backup takes a half hour to work. Each of the 170,000 bytes on the disk has to be loaded into the computer and then saved on the disk again, not to mention the time needed to format the new disk and for you to pop the disks in and out of the drive a half dozen times each. The same is true of Copy-all, except that it eliminates the need to change disks.

Commodore already makes a faster disk drive that is usable with the C-64. If time matters in your work, get a CBM 4040 disk drive and connect it to the C-64 with an Interpod or C64-Link interface. Doing a backup on the 4040 takes about two minutes.

Loading or saving a program with a 4040 disk drive is four times faster using the C-Link than using the Interpod or the 1541 disk drive. But the Interpod will work more easily with some programs than will the C-Link interface.

Commodore also has a Speed-up ROM that increases 1541 disk throughput by 25 percent and fixes some troubles noticed by C-64 owners with two 1541 disk drives. It should be available through your local dealer by the time you read this.

* * *

I've heard the VICMODEM has some sensitivity problems. What type of modem would you recommend?

Trin Wooten
Rossville, GA

The VICMODEM reportedly works best on the series 500 Western Electric pushbutton phones, but still isn't as sensitive as some other modems. At the moment, my favorite modem is the D.C. Hayes SmartMODEM 1200. It costs as much as six VIC-20s and needs an RS232 interface to the VIC-20 or C-64, but it does everything a modem should.

Commodore's 1650 modem is newly available, at a very attractive cost. It is more reliable than the VICMODEM, plugs directly into the wall and has automatic dialing.

* * *

About Steve Punter's terminal program, adapted to the VIC-20 and C-64 by Keith Peterson...does it use the VICMODEM? And is it compatible with the C64-Link? Could you also review procedures for getting programs from the ASM/TED user group?

Gary Stone
Annapolis Junction, MD

Yes, terminal.64 and terminal.vic use the VICMODEM. The C64-Link should be compatible, although you may have to use its relocator. Both programs, along with a version for larger Commodore computers, are included on The Terminal Disk, which I put together for Keith Peterson to relieve him of requests for copies of the programs. I ask $15 per copy, including disk, mailing, etc., and usually send the disk the same day I receive the order. The last update was August 26, 1983.

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ATUG (ASM/TED User Group) is open to all, without membership fee. Its main function is to exchange disks of public domain programs, especially source code for machine language programs. Its disks cost $10 and are available from Brent Anderson, 200 S. Century, Rantoul, IL 61866. Send him a double-stamped, self-addressed envelope for a list of current offerings, and allow several weeks for a reply, as he is swamped with other work now.

* * *

I have your Subsort for some programs I wrote, and use it in Bill Brown's Financial Report program (from Midwest Software). I recently purchased PETspeed to speed things up, but found that the machine language sort doesn't work with the compiled program. Do you have a way to do this?

Brother Timothy Brady
Bronx, NY

Sorry, but I don't. PETspeed stores its variables in a different way than Basic. Thus, Subsort no longer knows where to find the information it needs. A possible alternative is DTL BASIC ($350 from CMD, Milton, Ontario). It is also a full compiler, but doesn't alter the way Basic arrays are stored. A version for the C-64 has just been announced.

Another alternative would be to write a substitute sort in Basic and compile it in PETspeed. A compiled Quicksort or Heapsort might be fast enough for your needs. I'll try to round one up for a future issue.

* * *

I am trying to purchase a printer that will print the APL character set. Do you know of an APL-compatible printer for under $1000?

Tony Klinkert
Carrollton, TX

The Epson FX-80 should meet your needs at a list price of about $650. It includes the ability to down-load *any* character set from a computer into its memory. You will, however, have to design the APL characters yourself, and then load them into the printer each time you turn it on.

* * *

I'm writing for some advice on locating appropriate statistics software on disk for my C-64. I'm hoping to record bird migration data for as many as 35 variables relating to species, numbers and weather for up to 120 consecutive days during any given spring or fall. Moreover, I need to be able to conduct detailed statistical analyses with the recorded data.

I am most interested in functions such as averages, medians, standard deviation, correlation, linear regression, etc. Graphing or bar-charting capability is desirable but not imperative.

Mark Blauer
Nanticoke, PA

Sounds like a case for Calc Result: Advanced Version ($140 from Computer Marketing Services, Cherry Hill, NJ). It isn't a statistics package as such, but has a huge capacity and is able to merge information from several pages of disk data into a summary page.

Because it is primarily a spreadsheet program with extensive calculation ability, you can add in almost any statistics functions you need, and it does include high-resolution graphing ability.

* * *

I tried the Data/20 80-column board for the C-64, but couldn't even get a picture on my color TV. The dealer said to buy an amber or green phosphor monitor instead. Must I?

Connie Archambault
Meriden, CT

Yes. The problem is that ordinary TVs are made to distinguish only about 40 columns of text, and you're asking them to handle twice that many when you try to send 80 columns. The only alternative is to use narrower characters, an approach taken by a new program, Color 80 ($30 from Richvale Telecommunications, Toronto, Ontario), that generates 80 columns on an ordinary TV. However, that approach means each screen character is composed of less than half as many dots as usual, making its outline very rough. Go with your dealer's recommendation. R

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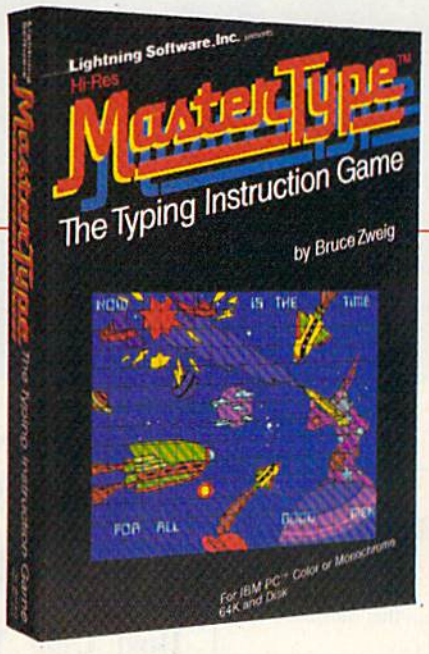

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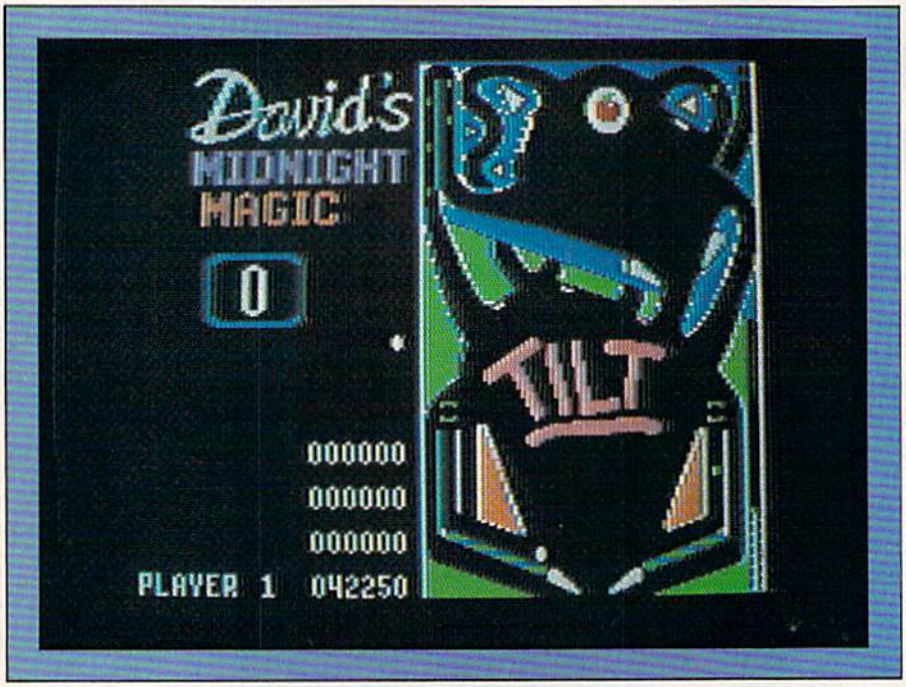
Software Gallery

Compiled by Shawn Laflamme



Report Card

A—Superb!
An exceptional program that outshines all others.

B—Very good.
Satisfies above all expectations. A real winner!

C—Good.
Lives up to its billing. No hassles, headaches or disappointments here.

D—Fair.
There could be some problems, but if you're able to overcome them, you'll find this worthwhile.

E—Poor.
Substandard, with many problems. Should be deep-sixed!

David's Midnight Magic

Hold Onto Your Flippers—Here's Pinball Excitement Just Like the Arcades

A

David's Midnight Magic will keep you up all night. Lower the sound and shut your door, though, or the bleeps and blurps and colorful graphics will keep others up all night too. Then again, maybe no one will want to go to bed—this pinball game allows up to four players.

This game is a refreshing change of pace from the all-too-predictable games on the market today. If you're tired of shoot 'em-ups and blast 'em-downs, then you'll enjoy David's Midnight Magic. Parents will enjoy playing it with their youngsters. It's a treat to play a game that doesn't operate out of the "destroy or be destroyed" motif.

You don't have to blow up any missile sites or stomp on any little green men who are trying to chop you to pieces—you only have to keep in action a tiny white ball that triggers funny noises and blinking colors.

Neither torpedoes nor gold stars are given as prizes—your only reward is points. And you're going to bash that ball forever if you don't score as well as your contender.

Reduced to its simplest terms, David's Midnight Magic is a challenging game of skill against gravity that promises to provide many hours of entertainment.

Although there is only one level of play, and you can't adjust the speed of play, this game offers enough variety and excitement to hold your interest for a long time.

David's Midnight Magic was originally written for the Apple computer and converted for the Commodore 64. In fact, one of the bumpers in the Commodore disk version depicts a bright, red apple, symbolic of the program's origins. This conversion makes excellent use of the Commodore 64's graphics capability.

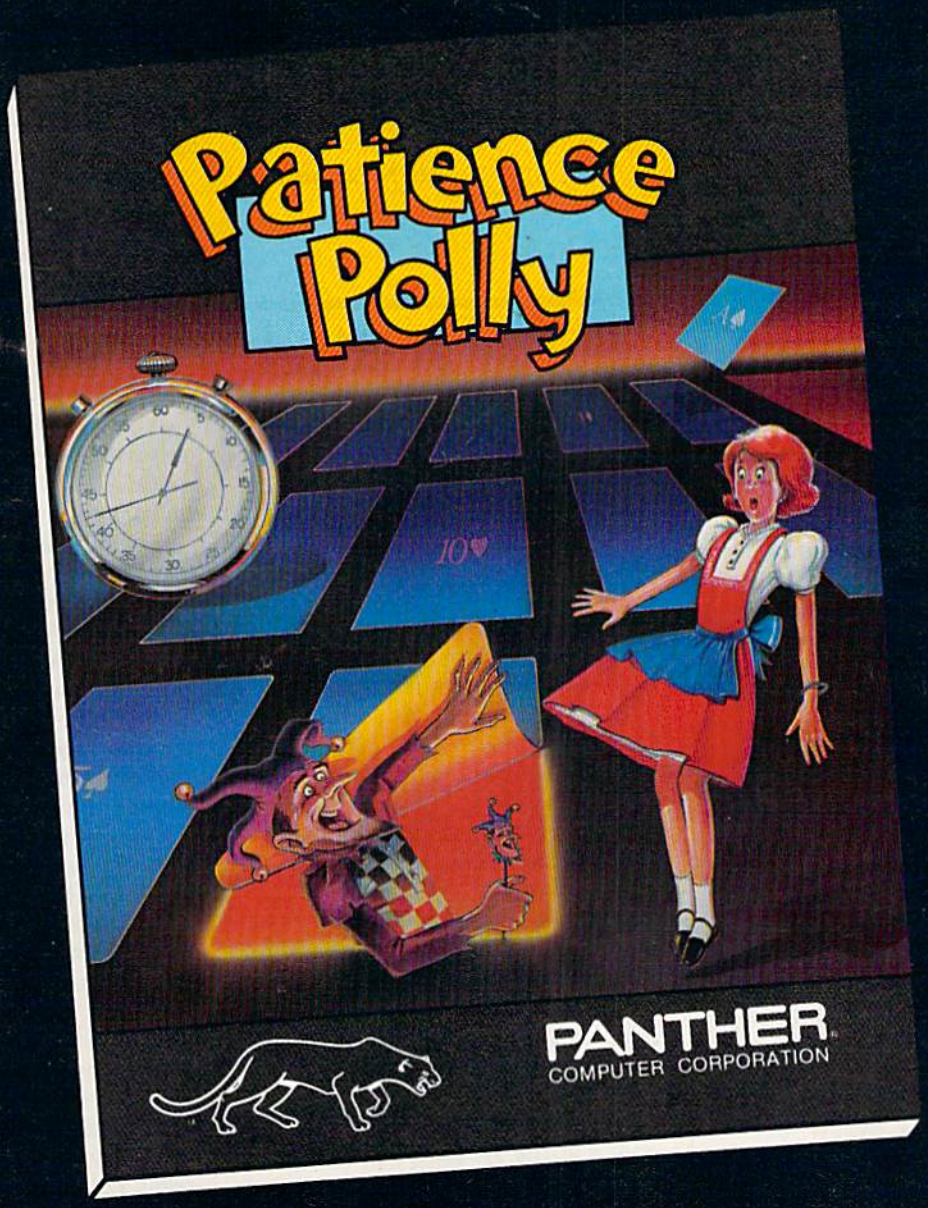
DMM features multiple-ball play, roll overs and fast bumper action to make the game more realistic, and if that's not enough, you can also adjust the spring tension (with keys F5 and F7) before launching the ball.

You are allowed five balls per game, but if you manage to flip a ball or two or three into the S-shaped ball collector, you might also end up juggling one or two or three balls if you release them

WARNING:

Don't Play this Game.

(Habit Forming)



Commodore 64 disc retail price: $29.95
VIC 20 cassette retail price: $15.95

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Circle 162 on Reader Service card.

You don't need lightning reflexes, but you can't go to sleep, either.

from the trap. In the process, you can rack up extra balls and bonus points.

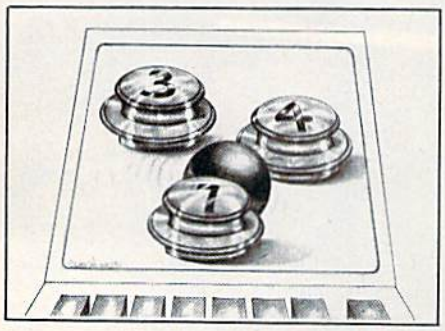
You control the dual flippers with the Commodore key (for the left side) and the shift key (for the right side). If you don't lose the ball by letting it slip through your controls, you might lose it down one of the side columns. If you're quick, however, you can probably save it by using the Magicsave magnets when they are activated. Press any key in the bottom row of characters (Z–V for left column, M–/for right column).

Two especially interesting features of the game are the permanent scoreboard, which records on disk the top ten scores (in our case, these range from 356,600 to 535,620), and the pause feature, which lets you freeze the action on the board by pressing the run/stop key. The challenge is to beat your previous score and establish some sort of computer immortality by registering your initials on the top-ten scoreboard.

Another realistic feature of the game is the ability to jostle the machine by pressing the space bar. But don't rely on this feature too often, or the machine will tilt and you will lose your points.

This is an addictive, well-designed game that combines fast, exciting action; colorful graphics; and lifelike sound effects. The game rings true, as does the bounce of the ball, whose adherence to the laws of motion and gravity would please even the most critical natural scientist.

DMM is not so much a game of speed and force, but of timing. As in arcade-style pinball, how hard you strike the ball is not as important as how precise you are in manipulating the flippers to control the ball's flight.



Those of you who have never played pinball will be in for a treat, while those of you who've enjoyed pinball at the arcade will be especially thrilled by the realistic sounds and actions of this game. And it's free (after the initial purchase, of course) so you can afford to play it all night. *(Brøderbund Software, 1938 Fourth St., San Rafael, CA 95901. $34.95.)*

RUN Editorial Staff

Rescue at Rigel

Can You Beat the Odds In Your One-Man Raid To Free the Hostages?

Most home computers are at their worst when trying to emulate the $4000 dedicated arcade machines, but at their best when running an adventure. Arcade machines demand a time when that next quarter goes in the slot. Home computers, unhampered by this design restraint, can run games that go on for weeks.

Can you imagine an arcade machine that says, "You have just taken a 242-unit from the Klingon at quadrant 1-3; deposit 25 cents!" or "The chain armor is 75 cents. Offer me not less, oh mighty warrior." Get lost, Mac; it will never fly.

No; adventures are a home phenomenon, and the art form is developing as the home market improves in depth. That brings us to our present subject, an adventure called Rescue at Rigel, with a one-hour time limit. You don't need lightning reflexes, but you can't go to sleep, either. The version reviewed here runs on the VIC-20 with mandatory 16K expansion.

Rescue at Rigel is a space-oriented, dungeon-type adventure, where you are placed within a 60-room asteroid and given the task of rescuing hostages with your transporter. It is a survival game, as you score best when you also rescue yourself. Evading the various aliens is at least as good as zapping them, because aggression costs some of your finite store of energy, while making tracks does not.

Each command has its own single key, so you don't have to seek a correct word as in some adventure games. To move, you press a number. R turns you right, L turns you left, and so on. Other keys let you fire, fight, turn shields on and off, or jump into a bionic "fight or flight" mode.

Special Commands

Other commands confer the ability to call the transporter room of your starship, to use some of your limited healing potions, or (we both loved this one) to ask the "insectoid" monsters if they are friendly or not. They sometimes are, but if you're greeted with "alien scum" then stand by for a raster blast.

You can shoot it out, but since this is a survival game, you can also raise shields, dodge, or just plain make yourself scarce and still score well.

Loading and continued operation is trouble-free. Once data is loaded, it's there—no need to reload unless Fido jerks the plug out. The graphics section of the screen, showing a plan view of your current location in a room, is refreshed with little delay as you move to another room. Status shows clearly at the top of the screen at all times, and the sound prompts are useful and entertaining as you look for randomly scattered hostages and meet the challenges.

Three different levels of difficulty exist, so familiarity will not breed contempt. Part of the challenge is that you must monitor wounds, fatigue, energy and other essentials in real time. When fatigue drops to 0, you can't move. When wounds get to 0, you find you have not survived. You *can* keep going at Rigel when your power pack runs out of energy, however, and you will save many points if you do manage to survive.

This role-playing game has obviously been carefully tested. To improve future editions, we'd suggest paying more attention to the VIC's keyboard buffer. Commands entered in a frenzy of action will "back up" on the machine unless cleared, and will then execute one at a time before your horrified eyes.

Also, scoring could be more rational. We got 270 points or so for rescuing four hostages and barely escaping with our lives, whereas just beaming straight back to the mother ship immediately after starting up can yield 479!

Pauses?

What about pauses in a real-time game? The argument for them is that you do not have to abandon a game in process if the phone rings. The argument against them is that it considerably waters down the real time nature of the contest for those who cannot resist pausing when things get hot.

By experimenting, we found that you can sometimes pause this game by pressing run/stop, and then entering CONT later. The clock stops while halted this way. Should this be an official game option?

There are neat features in this game. All the commands are echoed at the lower left of the screen, allowing onlookers to follow what is going on. Sound is prolific and varied. Part of the strategy is escaping by Transporter when you feel you can't effect any more rescues. This ends the game, but you escape with your hostages and score a lot more for getting out alive.

The ample manual of lore always included by Epyx will set the scene for you in some detail before you begin. Some aliens are meaner than others, so you need this running start. Rescue at Rigel is a game that will show off your computer at things it can do really well. *(Epyx, Inc., 1043 Kiel Court, Sunnyvale, CA 94089. $29.95.)*

Ron Gunn and Mike Zimmerman
Livermore, CA

Choplifter

This Whirlybird Game Is Set for Destruction And High Adventure

C

In Tom Griner's Choplifter, you direct a helicopter horizontally and vertically, in a style much like that of Defender (the coin-op game), except that a new wrinkle exists: If you press the joystick button a tad longer than usual, you control turns. Your copter can even glide sideways through the sky, while still facing you. It's a new ballgame, perspective-wise.

Ordinary button-presses launch either bullets or bombs, depending on whether your helicopter is sliding sideways or travelling straight ahead (or in reverse). During regular travel, you can fire bullets; during side-gliding, you can drop bombs.

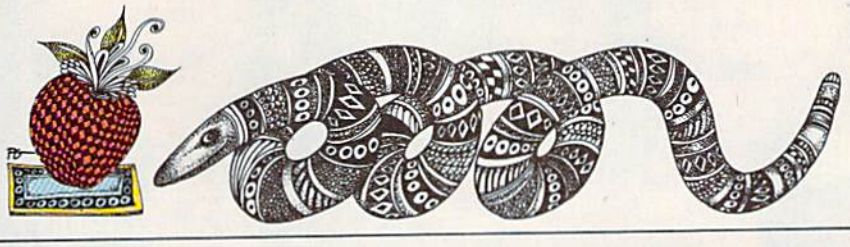
Your mission is to save hostages. You must pick them up and bring them to homebase. Sometimes you must blow up prisons to free the poor devils. When you're filled up, you must deposit the brood home before rescuing more. While you're being harassed by jets in the sky, tanks on the ground fire at you. People can be blown up separately by the enemy.

Tank fire "loops up" toward you in a fascinating 3-D simulation that is hard to describe. Missiles from the foreground fly to the "back" of the picture. You must dodge enemy fire by managing turns and dipping in and out. On the higher levels of difficulty, skill and reflexes are tested to the limit.

The graphics come alive in the way angles and patterns of movement are depicted—such as people running out of the helicopter and dispersing after it lands. You can leave the site following a prison blow-up, returning later to see the people in the same position as you left them. Nice effect; however, other scenes lack continuity. Enemy aircraft left behind you and out of sight of the scrolling screen seem to disappear. When you return to the spot, they're gone. It's slightly inconsistent.

Overall, I enjoyed this VIC game. I was fascinated by designer Tom Griner's well-wrought ideas. The subtle tricks of the game, involving fire and movement, make this a special treat for shoot 'em-up fans. *(Creative Software, 201 San Antonio Circle, Mountain View, CA 94040. $39.95.)*

John DiPrete
Cranston, RI



Snake Byte

This Sibilant Snake Slithers in Search Of Succulent Sustenance

B

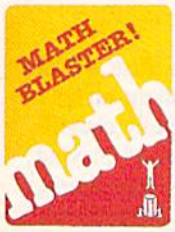
Snake Byte is not the first of its type, but it is a refreshing novelty compared to the bulk of easily classifiable games. One gets tired of playing shoot 'em-ups, maze-type scenarios, adventure games and jump-a-thons. This is truly different!

Your keyboard controls the direction of a growing snake, which turns by moving at right angles to itself—north, south, east or west. Your playful reptile stretches when it gulps an apple. The longer it gets, the more difficult it is to manipulate. Your pet's speed is automatic and ever-quickening (the pace accelerates with its elongating stomach-linings).

The goal is to swallow ten apples per level by gliding over them separately. A new apple pops up each time one is eaten. If you take too long to line yourself up and nip a target, three penalty apples appear. Every time your snake hits a screen border or smacks into itself, you lose.

Watch out for the lazy, random-moving and deadly "perilous purple plums." They will destroy your snake if any of them hit his head. At the start of the game you can set the number of

Educational Software That Works



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plums that eventually appear.

Twenty-nine skill levels exist. You get to shed your mortal coil (die) only thrice, but if you complete a level all in one piece, you receive an extra slitherer. Byting apples successfully scores points for you. If plums are bumping around, it means apples are worth more.

I had the time of my life trying to get past level one of this charmer. The concept is so fresh it tingles—like a snake bite. Great stuff! On C-64 disk and VIC cartridge. *(Sirius Software, Inc., 10364 Rockingham Drive, Sacramento, CA 95827. $29.95)*

John DiPrete
Cranston, RI

River Rescue

Don't Rock the Boat— Speed and Agility Needed For the Race of Your Life

If you've been seeking a game for the VIC-20 computer that compares favorably to Apple, Atari, or ColecoVision games, it's finally here. River Rescue is one of the first programs for the VIC that really utilizes the machine's graphics and sound capabilities. And besides that, it's fun!

As a child, I lived alongside a river, and my favorite memories are of hot summer days cooled by the spray of water from our speeding motorboat. River Rescue brings back those memories with the realistic sound of the boat's motor and the stream of water spurting from the back of the boat. The river itself seems quite real with its twists and bends and its wide and narrow passages.

As you speed down the river, you encounter certain obstacles you must destroy, including crocodiles, anacondas and dugout canoes. In addition, you occasionally hear an SOS signal that alerts you to the location of three explorers waiting at three separate jetties for you to pick them up. When you have finally succeeded in rescuing all three, you must take them to a final jetty and dock there. The screen then changes to a different-colored river with more obstacles

and more explorers to rescue.

Speed and Skill

You earn points by destroying obstacles, rescuing explorers, maintaining speed and completing each course. Lives are lost by hitting obstacles, the bank or the jetties. You entirely control the speed of the boat; you can move very slowly, which will earn you no points, or you can travel at an incredibly fast speed, which will earn you lots of points, but only if you stay alive!

It's not easy to move quickly and still avoid or destroy all the obstacles; it's also fairly difficult to dock at the various jetties. Fortunately, you have the option of three or six lives. In the beginning, at least, you'll probably need all six.

The game comes in cartridge form for the unexpanded VIC. There is a one- or two-player option, so you can play alone or challenge your friends.

River Rescue ranks with any computer game I know. The sound is excellent, the scrolling graphics are good, and the game is very playable. A program such as this will certainly contribute to the continued success of the VIC-20 computer. Its true capabilities are finally being realized as more and more companies develop high quality software for this machine.

Meanwhile, climb aboard and race on down the river with River Rescue. It may be the most fun you ever had with your VIC! *(Thorn EMI, 1370 Ave. of the Americas, New York, NY 10019. $39.95.)*

Shelby Goldstein
New York, NY

As you race on down the river, you must avoid obstacles and rescue explorers.

Sword of Fargoal

Magical Monsters Block Your Quest For the Treasure

Sword of Fargoal, a fantasy game for the VIC-20 with 16K expander, is a dungeon adventure filled with magic, suspense and challenge. Your goal is to find the sword of Ulma, hidden between the 15th and 20th levels of a 20-tiered dungeon. Incredibly armed with scads of pocket-miracles discovered en route, you defend yourself with light spells, shields, healing potions, invisibility and much more. Your joystick controls movement in eight possible directions.

As you explore, you light up the darkness, leaving areas of brilliance in your wake (apparently, you plant torches on your journey). Your computer screen keeps tabs on the action (experience points, dungeon levels, number of monsters slain, and so on), warns you of approaching beasties, decides battles on the basis of point-levels and relates the outcomes of fights with such charming lines as, "You have defeated a weak, dire wolf."

You soak up power, experience points and battle skills by demolishing critters like ogres, hobgoblins, werebears, gargoyles, wyvern, shadow dragons, trolls, fire drakes and dimension spiders (beware of this last, for they sneak in and out of dimensions). Delightful spells charge the trip with fascination. For instance, light spells illumine the area beyond normal range; teleport spells are useful in evading danger by zapping you to a random section of the dungeon; healing potions restore your health and vigor, and so on.

In addition to wiping out monsters, you collect gold pieces for experience points. A magic sack allows you to carry an extra one hundred pieces, and if you wish, you can bury the gold (press "B" on the keyboard) and retrieve it later. You may also choose to sacrifice it at a temple, thereby gaining additional experience points. Alas, be wary at all times of thieves out to steal your treasure!

Countless keyboard decisions frantically determine your fate. Besides the uses described above, you may also plug in commands to climb up or down stairs (press C or D, respectively) or to bypass monsters (P).

The color graphics present a competent picture, superior to another fine Epyx adventure, Escape From Vulcan's Isle. Playing time is thirty minutes to several hours, and the game is designed for a solitary player. The rules booklet is 19 pages in length, well-illustrated with black-and-white and green-and-white drawings by popular fantasy artist George Barr.

The game is easy to play and is highly recommended for all magic lovers, ages ten through adult. For the novice searching for a good entry-level spell and sorcery game, this is the place to start. *(Epyx, Inc., 1043 Kiel Court, Sunnyvale, CA 94089. $29.95.)*

John DiPrete
Cranston, RI

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The Sim software family teaches, entertains, and makes many jobs easier. Its members perform like you've never seen before. Every Sim program can teach you a new trick. Even our application and game software deliver educational extras. **All at a very affordable price.**

Sim gives you those special little touches which make our software such a great value. The INSIDE BASIC SERIES for example. We give you the ability to learn from the program. After you have bet on the horses in KENTUCKY DERBY, devised trivia questions to stump your friends with QUIZ ME, or created invoices for your hobbycraft sales with FORM GENERATOR, you just might want to see how the program was put together. So we've included the programmer's notes†. Budding programmers can use these notes to change the odds on the horse race, insert a special feature in a quiz, or add a custom wrinkle to a form. Sim gives you the power to do it.

ALL INSIDE BASIC programs come with both the Commodore 64 and VIC 20 versions on the same disk or cassette. If you plan to upgrade to the Commodore 64, *you won't lose your investment in software.* And if you have both computers you can use the program on either unit.

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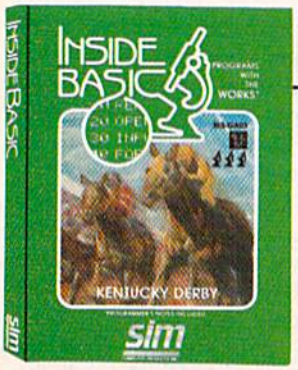
†Programmer's notes available free with response card and include program overview, line by line description, complete listing, variable chart, and suggested changes.

Entertainment



Kentucky Derby Bet on your favorite horses

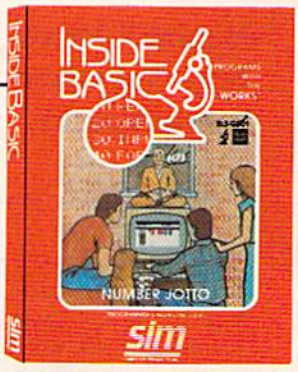
There's nothing more fun than a day at the races. Especially when you don't have to leave your living room. This popular program features colorful hi-resolution graphics and authentic sounds. Pick your favorite horse or ask Hot Tip Sam. Bet to win, place, or show and watch them gallop off! Experience the thrill as your horse crosses the finish line and your payoff appears on the tote board. KENTUCKY DERBY is an exciting game for all ages and may be played with up to four players.

Commodore 64/VIC 20+8K
(suggested retail: $19.95)*

Number Jotto Outwit your opponents

Deduction, logic, and patience are the skills you must master to win the game. The object is to discover your secret jotto number using the least number of tries. Each move is your probe that the computer must respond to with two hints. Think carefully, examine your guess chart on the screen, eliminate and choose wisely. Your opponent may show no mercy. NUMBER JOTTO is an ideal strategy game for the entire family and may be played with up to four people.

Commodore 64/VIC 20+8K
(suggested retail: $14.95)*



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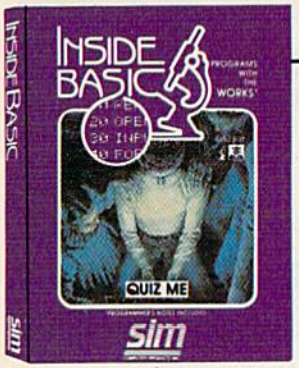
Education



Quiz Me Test your knowledge and build study skills

QUIZ ME is a computer aided testing program. Using its powerful editor, parents and teachers can easily create a quiz for any subject. You can load, save, and print out your quizzes. Create as many quizzes as you like with up to 50 problems per quiz on the Commodore 64.

QUIZ ME is designed to allow multiple choice, fill in the blanks, and for those questions where spelling is not important, approximate answers. You can specify the number of tries per problem. There are advanced features that allow you to specify the time you have to answer and the number of points awarded for each problem. Upon completion of the quiz, automatic scoring, percentage scaling, and letter grading give the student his complete results.

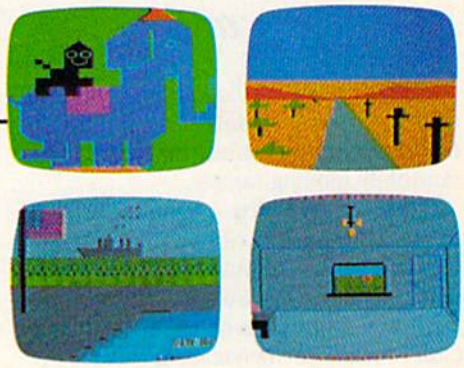
QUIZ ME gives continuous reinforcement and encourages you to try harder and learn more. QUIZ ME is an exceptional program for parents and teachers who wish to make learning more enjoyable.

Commodore 64/VIC 20+8K
(suggested retail: $19.95)*

Colorcraft Etch, sketch, and animate your way to a better understanding of computers.

Using the keyboard, children can create their own fun-filled stories with full color graphics. COLORCRAFT will then take their story and animate it on the screen. Hours of enjoyment await, and the fun does not have to end today. You can save your story for tomorrow.

Plus, COLORCRAFT helps children and adults become familiar with computer basics like cursors, graphics and function keys, and simple word processing commands. After a child learns the fundamentals, there are advanced features like speed control and diagonal cursor movement. COLORCRAFT comes with an easy to follow user manual including a glossary of computer terms and a step by step sample animation. COLORCRAFT will teach and entertain your entire family while stimulating your children's creativity.



Commodore 64/VIC 20-memory expansion not required
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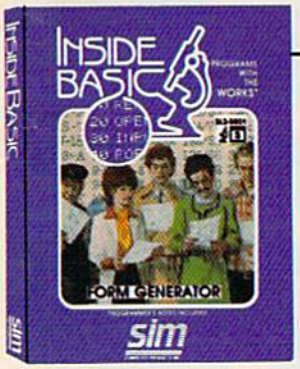

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Requirements: Commodore 1525, 1526 or compatible printer.
16K memory expander recommended on the VIC 20.

Features: labels and formulas: add, subtract, multiply, divide
automatic information prompting
default input values
fixed decimal number formatting
repeat sequences (a must for invoicing)
multiple copy printing

Commodore 64/VIC 20+8K
(suggested retail: $29.95)*

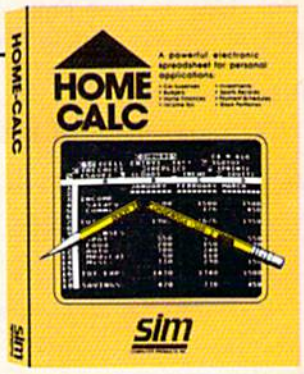
Home-Calc The lowest priced, easiest to use spreadsheet

Spreadsheets are one of the most popular programs and have many applications in the home: investments, payment schedules, home finances, car expenses, and more. The easy reading manual, simple instructions, and easy-to-execute commands make setting up a spreadsheet a snap. HOME-CALC doesn't confuse you with lots of fancy functions and commands. A beginner can have a home budget sheet working in an hour. If you're more sophisticated and want to use it in your business that's okay too. HOME-CALC is ready to handle "what if?, how much?, and bottom line" calculations. Load, save, and print spreadsheets.

Features: sum, replicate, recalculate
title and formula capability
add, subtract, multiply, and divide
selectable column width and number formats
machine language speed

Requirements: Commodore 1525, 1526 or compatible printer

Commodore 64
(suggested retail: $24.95)*



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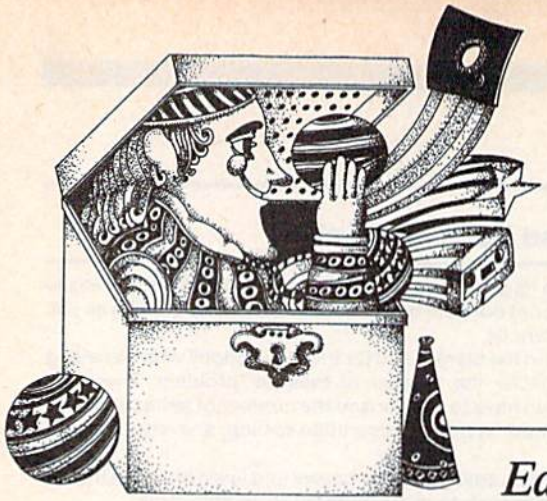


Video Casino

By David Busch

Each month, RUN *columnist, David Busch, will present original game programs you can type into your micro and enjoy. This first in a series is entitled Target Shoot.*

The shooting gallery was, and remains, a popular contest. It pits hand-eye coordination against the vagaries of randomly moving targets.

Some of the first computer games were adaptations of various target-shooting games. Sometimes the opponent was a video cowboy. Today, targets range from ships on the surface of a CRT ocean, to menacing Galaxian invaders.

Target Shoot gives you a rapidly moving target. A box moves across the top of the screen from left to right. On each pass it descends lower and lower, until the target eventually collides with your ship at the bottom of the screen. You can use the joystick to move the ship from side to side, keeping pace with the target as desired. Then, at the right moment, a press of the fire button releases a missile.

At this point, movement of the ship is frozen, and the joystick takes control of the missile. You maneuver the projectile closer to the enemy target. A hit triggers an impressive explosion. Careful planning can allow you to strike the target two, three or more times on a single pass, upping the score to new heights.

Helpful Variables

The program is laid out in several modules. The first step after the instructions is to initialize certain variables that will be used later in the program. By defining numbers that will be used over and over as variables, you will speed up program operation. Instead of evaluating the constant 6, say, every time the program encounters it, the computer uses the variable BLUE.

The computer can look up this variable in an internal table very quickly, since all variables are stored in the order in which the program uses them. Since you defined BLUE in line 200, it will be near the top of the variable lookup table. Instead of Poking a color memory location with 6 to change it to blue, you can Poke the variable BLUE, which is much easier to remember than the number six.

Similarly, instead of Poking a 32 to screen memory to get a space (CHR$(32)), you just Poke the variable SPACE, defined in line 230. Two other variables, CSCREEN and CHAR, are also defined, but for a slightly different reason.

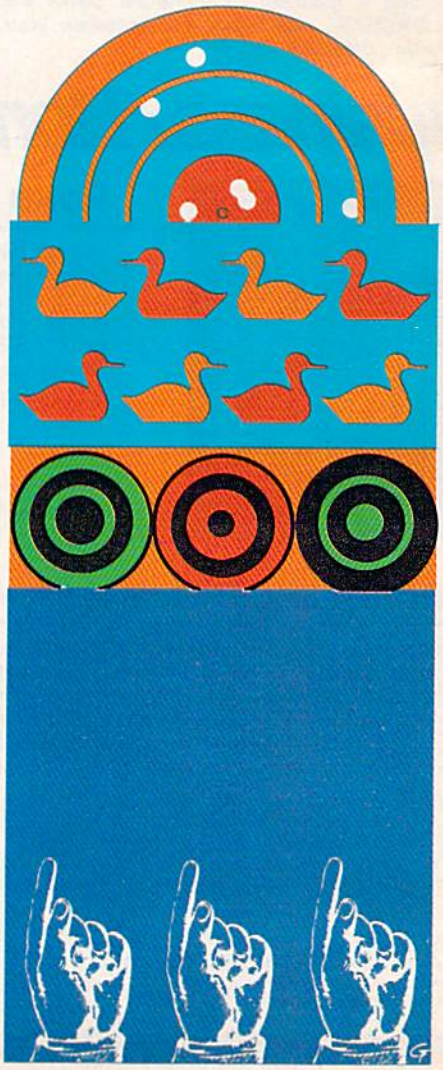
As you may know, the VIC-20 stores a record of what appears on the screen in a series of 506 memory locations. The character color of each of those locations is also stored in 506 memory slots. Changing the contents of any of those bytes will change the character in that screen position, or its color.

In the unexpanded VIC-20, the screen character codes are stored beginning at memory location 7680, and the color code memory map starts at 38400. Unfortunately, these memory locations change, depending on how much memory has been added to the VIC-20. That's why some of the games you purchase specify that they are only for unexpanded VIC-20s.

A program which has a line like the following:

```
10 POKE 7680,81:POKE 38400,6
```

will produce a blue ball on the screen of an unexpanded VIC-20, but will print nothing with a VIC that has more than a 3K memory expander.



RUN It Right

Unexpanded VIC-20 or Commodore 64

Address author correspondence to David D. Busch, 5217-C Cline Road, Kent, OH 44240.

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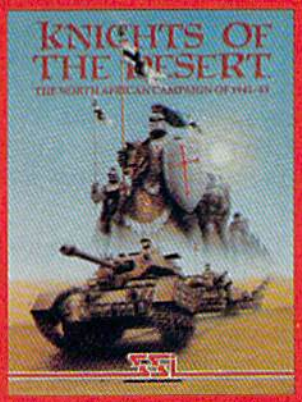
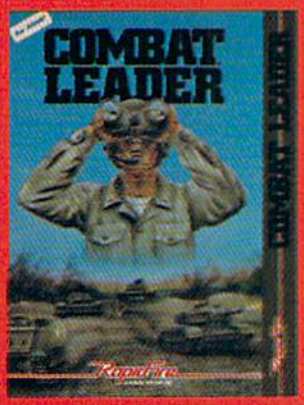
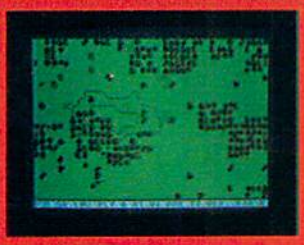


The North African Campaign of 1941-42 is faithfully recreated here. Just as knights on tall horses rode out on the First Crusade nearly a millenium ago, you'll have a chance to ride in your Crusader tanks against the invading Nazi forces. Disk & cassette. $39.95

2.





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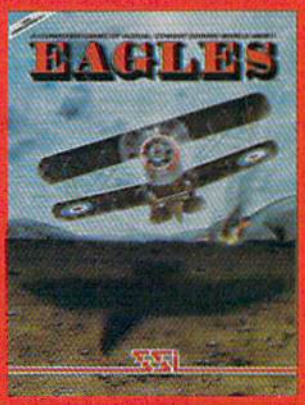

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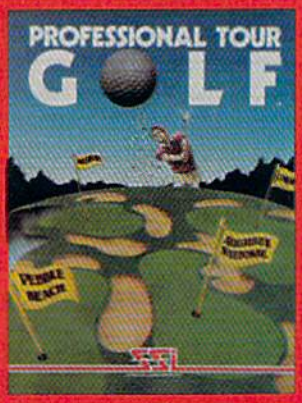

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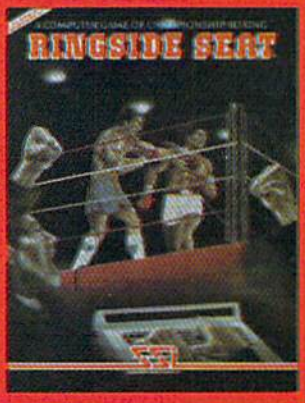

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Listing 1. Target Shoot program for the VIC-20.

```
1 REM VIC-20 VERSION
10 REM ****************
20 REM *               *
30 REM * TARGET SHOOT *
40 REM *               *
50 REM ****************
60 PRINT"[SHFT CLR][CRSR DN][CRSR DN]"
70 PRINTTAB(4)"[CTRL 9][CTRL 3]TARGET SHOOT[CRSR DN][C
    RSR DN]"
80 PRINTTAB(1)"USE JOYSTICK TO MOVE"
90 PRINTTAB(1)"YOUR BASE ON BOTTOM"
100 PRINTTAB(1)"OF SCREEN, AND TO "
110 PRINTTAB(1)"STEER YOUR ARROW.TRY"
120 PRINTTAB(1)"TO GET AS MANY HITS"
130 PRINTTAB(1)"AS POSSIBLE BEFORE"
140 PRINTTAB(1)"TARGET REACHES BOTTOM[CRSR DN][CRSR DN]
    "
150 PRINTTAB(6)"[CTRL 9][CTRL 3]HIT ANY KEY"
160 GET A$:IF A$="" GOTO 160
170 POKE36879,104
180 PRINT"[SHFT CLR]"
190 DF=30720
200 WHITE=1:CYAN=3:BLUE=6
210 RSPACE=160
220 ARROW=30
230 SPACE=32
240 CSCREEN=37888+4*(PEEK(36866)AND128):B1=CSCREEN
250 CHAR=4*(PEEK(36866)AND128)+64*(PEEK(36869)AND120):B
    =CHAR:E=CHAR+484
260 DF=CSCREEN-CHAR
270 DD=37154
280 PA=37137
290 PB=37152
300 POKE 37139,0
310 GOTO 390
320 POKEDD,127
330 S3=-((PEEK(PB)AND128)=0)
340 POKE DD,255
350 P=PEEK(PA)
360 S2=((PAND16)=0)
370 FR=-((PAND32)=0)
380 RETURN
390 PRINT"[SHFT CLR]"
400 SH=CSCREEN
410 PO=E
420 HITS=0:BALLS=0
430 BALLS=0
440 GOSUB320
450 IF SH-DF>PO GOTO 870
460 IF S3=0 AND S2=0 THEN GOTO 530
470 IF F2=1 THEN N1=N1+S2+S3:GOTO530
480 IF S3=1THENPO=PO+1:IF PO>E+22THENPO=E+22
490 IF S2=-1THENPO=PO-1:IF PO<ETHENPO=E
500 IF S2=-1 GOTO 520
510 POKE PO,65:POKEPO-1,32:GOTO530
520 POKE PO,65:POKEPO+1,32
530 SH=SH+1
540 IFF2=0 AND FR=1THENFL=1:LE=50:GOSUB1020
550 IF FLAG=1THENGOSUB620
560 IF F2=1THENGOSUB670
570 POKE SH,CYAN
580 POKESH-DF,RSPACE
590 POKE SH-1,BLUE
600 POKESH-DF-1,32
610 GOTO 440
620 N1=PO-22:F2=1
630 FL=0
640 POKE N1,ARROW
650 N1=N1-22
660 RETURN
670 H=PEEK(N1)
680 IFH=81THEN GOSUB 1020:GOTO 700
```

More

However, instead of Poking directly to a memory location, you can Poke to a relative location. Say that character memory begins at location X, and color memory at location Y. You can Poke the fourth position in each by typing POKE X+4 or POKE Y+4. If we define X and Y as the different starting points, depending on the amount of memory, then the same program will work in any VIC-20.

That's what is done in Target Shoot. Instead of X and Y, we use CSCREEN (for color memory) and CHAR (for character memory). Lines 240 and 250 Peek at a location that tells how much memory is available, and then calculates the actual positions for the respective memory maps.

To further simplify things, the difference (DF) between the two starting points is calculated. Then, if we want to Poke to the fourth position of each memory map, we simply type POKE CSCREEN+4 and POKE CSCREEN +4−DF.

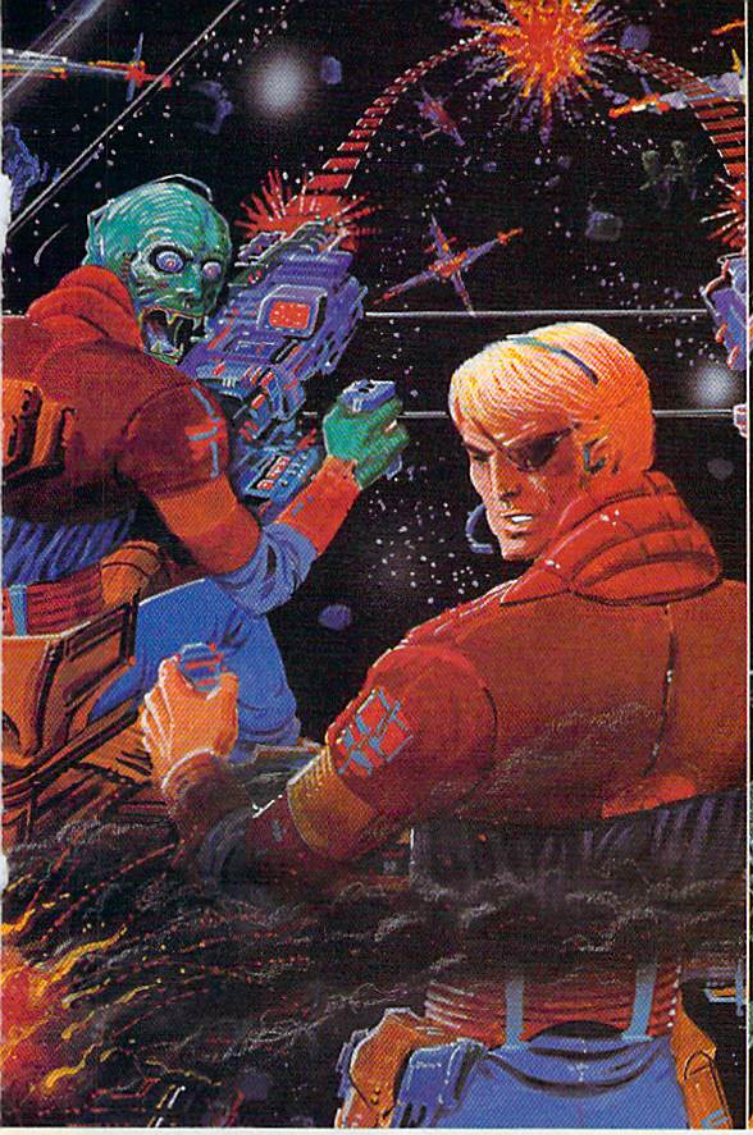
The reason for doing this is, for example, that the position of the ship (defined as SH) is changed as the player manipulates the joystick. Both the character and its color are changed in the new position by Poking the new values of SH and SH−DF with the character and color.

This article will not go into the details of how the VIC-20 reads the joysticks. That will be left for a later article. However, the actual module that does this is in lines 320 to 380. The routine returns values for variables S2, S3 and FR. The first two tell whether the joystick has been pressed to the left or to the right. Upward or downward movement is ignored.

In this case, the joystick was chosen instead of a paddle (which the VIC-20 also accepts) because the range of movement control can be finer with the joystick. Paddles move the object much faster, but a finer touch is needed to precisely position the object on the screen. The third variable, FR, tells the program whether or not the fire button has been pressed.

Movement of the ship is simple. If the joystick has been pressed to the right, then S3 equals one, and the position of the ship, PO, is incremented by one in line 480. A check is made to make sure that the base has not moved past the end (E) of the screen.

If the joystick has been pressed to the left, S2 equals minus one, and PO is decremented by one. Another check



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Circle 6 on Reader Service card.

Listing 1 continued.

```
690 IF H<>SPACETHENGOSUB770
700 POKE N1,ARROW
710 POKEN1+22,SPACE
720 POKEN11+DF,WHITE
730 IF N1<CHAR+22 THEN F2=0
740 N1=N1-22
750 POKE N1+22,SPACE
760 RETURN
770 H=PEEK(N1):IFH=81 THEN RETURN
780 FOR N2=1 TO 50
790 GOSUB1020
800 POKE36879,25
810 POKE36879,104
820 NEXT N2
830 POKE36879,104
840 F2=0
850 HITS=HITS+1
860 RETURN
870 POKE7910,81
880 POKE 38630,4
890 PRINT"[SHFT CLR]"
900 PRINT"[CTRL 8][SHFT Q][SHFT Q][SHFT Q][SHFT Q][SHFT
    Q][SHFT Q][SHFT Q][SHFT Q][SHFT Q][SHFT Q][SHFT Q
    ][SHFT Q][SHFT Q][SHFT Q][SHFT Q][SHFT Q][SHFT Q][
    SHFT Q][SHFT Q][SHFT Q][SHFT Q][SHFT Q]"
910 PRINT"      [CTRL 2]GAME OVER"
920 PRINT"[CTRL8][SHFT Q][SHFT Q][SHFT Q][SHFT Q][SHFT
    Q][SHFT Q][SHFT Q][SHFT Q][SHFT Q][SHFT Q][SHFT Q]
    [SHFT Q][SHFT Q][SHFT Q][SHFT Q][SHFT Q][SHFT Q][S
    HFT Q][SHFT Q][SHFT Q][SHFT Q][SHFT Q][3CRSR DNS]"
930 PRINT" HITS:     ";HITS
940 PRINT"[CRSR DN] SCORE :";HITS
```

More

makes sure that the ship doesn't leave the left side of the screen. Then PO is Poked with the ship character, 65, and its previous position (either PO+1 or PO−1, depending on direction of movement) is Poked with a space,32.

Next, the position of the target, SH, is incremented by one (the target always moves from left to right), and a reverse space is Poked in its new location. The former position is Poked with a space.

Once the fire button has been pressed, a missile, ARROW, is released to position N1, through appropriate Poking. Now, movement of the joystick will control N1's value to the left or right. With each "turn," however, N1 decreases by 22 to move it one row higher on the screen.

The program periodically Peeks to see what lies in the space next to be occupied by the missile. If it does *not* equal a space, then a collision has taken place, and control branches to a routine that causes the explosion and increments the score counter, HIT, by one.

When the missile reaches the top of the screen, the player can resume control of the ship and repeat the cycle, until the target reaches the bottom, and the game is over. R

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Listing 1 continued.

```
950 IF HITS>HSTHENHI=SCR:PRINT"[CTRL 6] [CRSR DN]NEW HI
    GH SCORE![CTRL 1]":HS=HITS
960 PRINT"[CRSR DN] HIGH:";HS
970 PRINT"[CRSR DN]      [CTRL 9][CTRL 8]PLAY AGAIN?"
980 GET A$:IF A$=""GOTO980
990 IF A$="N"THEN END
1000 PRINT"[SHFT CLR]":GOTO390
1010 GOTO 390
1020 POKE36878,15
1030 POKE 36876,255
1040 FOR G1=1 TO LE
1050 NEXT G1
1060 POKE 36878,0
1070 LE=0
1080 RETURN
```

Listing 2. Target Shoot program for the C-64.

```
10 REM ****************
20 REM *               *
30 REM * TARGET SHOOT *
40 REM *      C-64     *
50 REM ****************
60 VOLUME=54296
70 VCE=54273
80 WAVE=54276
90 ATTACK=54277
100 SUS=54278
110 POKE 53281,14
120 FOR N=1 TO 10
130 READ R:JV(N)=R
140 NEXT N
150 DATA 0,0,0,-1,0,0,0,1,0,0
160 PRINT"[SHFT CLR][CRSR DN][CRSR DN]"
170 PRINTTAB(12)"[CTRL 9][CTRL 3]TARGET SHOOT[CRSR DN]
    [CRSR DN]"
180 PRINTTAB(8)"USE JOYSTICK TO MOVE"
190 PRINTTAB(8)"YOUR BASE ON BOTTOM"
200 PRINTTAB(8)"OF SCREEN, AND TO "
210 PRINTTAB(8)"STEER YOUR ARROW.TRY"
220 PRINTTAB(8)"TO GET AS MANY HITS"
230 PRINTTAB(8)"AS POSSIBLE BEFORE"
240 PRINTTAB(8)"TARGET REACHES BOTTOM[CRSR DN][CRSR DN]
    "
250 PRINTTAB(8)"[CRSR DN][CRSR DN]PLUG JOYSTICK INTO PO
    RT"
260 PRINTTAB(8)"CLOSEST TO POWER SWITCH.[CRSR DN][CRSR
    DN]"
270 PRINTTAB(12)"[CTRL 9][CTRL 3]HIT ANY KEY"
280 GET A$:IF A$="" GOTO 280
290 POKE 53280,0:POKE 53281,6
300 PRINT"[SHFT CLR]"
310 WHITE=1:CYAN=3:BLUE=6
320 RSPACE=160
330 ARROW=30
340 SPACE=32
350 CSCREEN=55296:B1=CSCREEN
360 CHAR=1024:B=CHAR:E=1983
370 DF=CSCREEN-CHAR
380 GOTO 430
390 JV=PEEK(56320)
400 FR=JVAND16
410 JV=15-(JVAND15)
420 RETURN
430 PRINT"[SHFT CLR]"
440 SH=CSCREEN
450 PO=E+20
460 HITS=0
470 F2=0
480 GOSUB390
```

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Listing 2 continued.

```
490 IF SH-DF>PO GOTO 910
500 MOVE=JV(JV)
510 IF F2=1 THEN N1=N1+MOVE:GOTO560
520 PO=PO+MOVE:IF PO>E+40 THEN PO=E+40
530 IF PO<ETHENPO=E
540 POKE PO,65:POKEPO-1,32:POKE PO+1,32
550 POKE PO+DF,1
560 SH=SH+1
570 IFF2=0 AND FR=0THENFL=1:LE=50:GOSUB1030
580 IF FLAG=1THENGOSUB650
590 IF F2=1THENGOSUB700
600 POKE SH,CYAN
610 POKESH-DF,RSPACE
620 POKE SH-1,BLUE
630 POKESH-DF-1,32
640 GOTO 480
650 N1=PO-40:F2=1
660 FL=0
670 POKE N1,ARROW
680 N1=N1-40
690 RETURN
700 H=PEEK(N1)
710 IFH=81THEN GOSUB 1030:GOTO 730
720 IF H<>SPACETHENGOSUB800
730 POKE N1,ARROW
740 POKEN1+40,SPACE
750 POKEN11+DF,WHITE
760 IF N1<CHAR+40 THEN F2=0
770 N1=N1-40
780 POKE N1+40,SPACE
790 RETURN
800 H=PEEK(N1):IFH=81 THEN RETURN
810 FOR N2=1 TO 50
820 GOSUB1030
830 POKE 53280,1
840 POKE 53280,0
850 NEXT N2
860 POKE 53280,0
870 POKE 53281,6
880 F2=0
890 HITS=HITS+1
900 RETURN
910 PRINT"[SHFT CLR]"
920 PRINT"[CTRL 8][SHFT Q][SHFT Q][SHFT Q][SHFT Q][SHFT
      Q][SHFT Q][SHFT Q][SHFT Q][SHFT Q][SHFT Q][SHFT Q
     ][SHFT Q][SHFT Q][SHFT Q][SHFT Q][SHFT Q][SHFT Q][
     SHFT Q][SHFT Q][SHFT Q][SHFT Q][SHFT Q][SHFT Q][SH
     [SHFT Q][SHFT Q][SHFT Q][SHFT Q][SHFT Q][SHFT Q][S
     HFT Q][SHFT Q][SHFT Q][SHFT Q][SHFT Q][SHFT Q]"
930 PRINTTAB(12)"[CTRL 2]GAME OVER[CRSR DN]"
940 PRINT"[CTRL 8][SHFT Q][SHFT Q][SHFT Q][SHFT Q][SHFT
      Q][SHFT Q][SHFT Q][SHFT Q][SHFT Q][SHFT Q][SHFT Q
     ][SHFT Q][SHFT Q][SHFT Q][SHFT Q][SHFT Q][SHFT Q][
     SHFT Q][SHFT Q][SHFT Q][SHFT Q][SHFT Q][SHFT Q][SH
     [SHFT Q][SHFT Q][SHFT Q][SHFT Q][SHFT Q][SHFT Q][S
     HFT Q][SHFT Q][SHFT Q][SHFT Q][SHFT Q][SHFT Q][CRS
     R DN][CRSR DN][CRSR DN]"
950 PRINTTAB(8)"HITS:     ";HITS
960 PRINTTAB(8)"[CRSR DN]SCORE :";HITS
970 IF HITS>HSTHENHI=SCR:PRINTTAB(8)"[CTRL 6] [CRSR DN]
     NEW HIGH SCORE![CTRL 1]":HS=HITS
980 PRINTTAB(8)"[CRSR DN] HIGH:";HS
990 PRINTTAB(12)"[CRSR DN][CTRL 9][CTRL 8]PLAY AGAIN?"
1000 GET A$:IF A$=""GOTO1000
1010 IFA$="N"THEN END
1020 PRINT"[SHFT CLR]":GOTO430
1030 POKE VOLUME,15
1040 POKE WAVE,33
1050 POKE ATTACK,128
1060 POKE SUS,128
1070 POKE VCE,40
1080 POKE VOLUME,0
1090 RETURN
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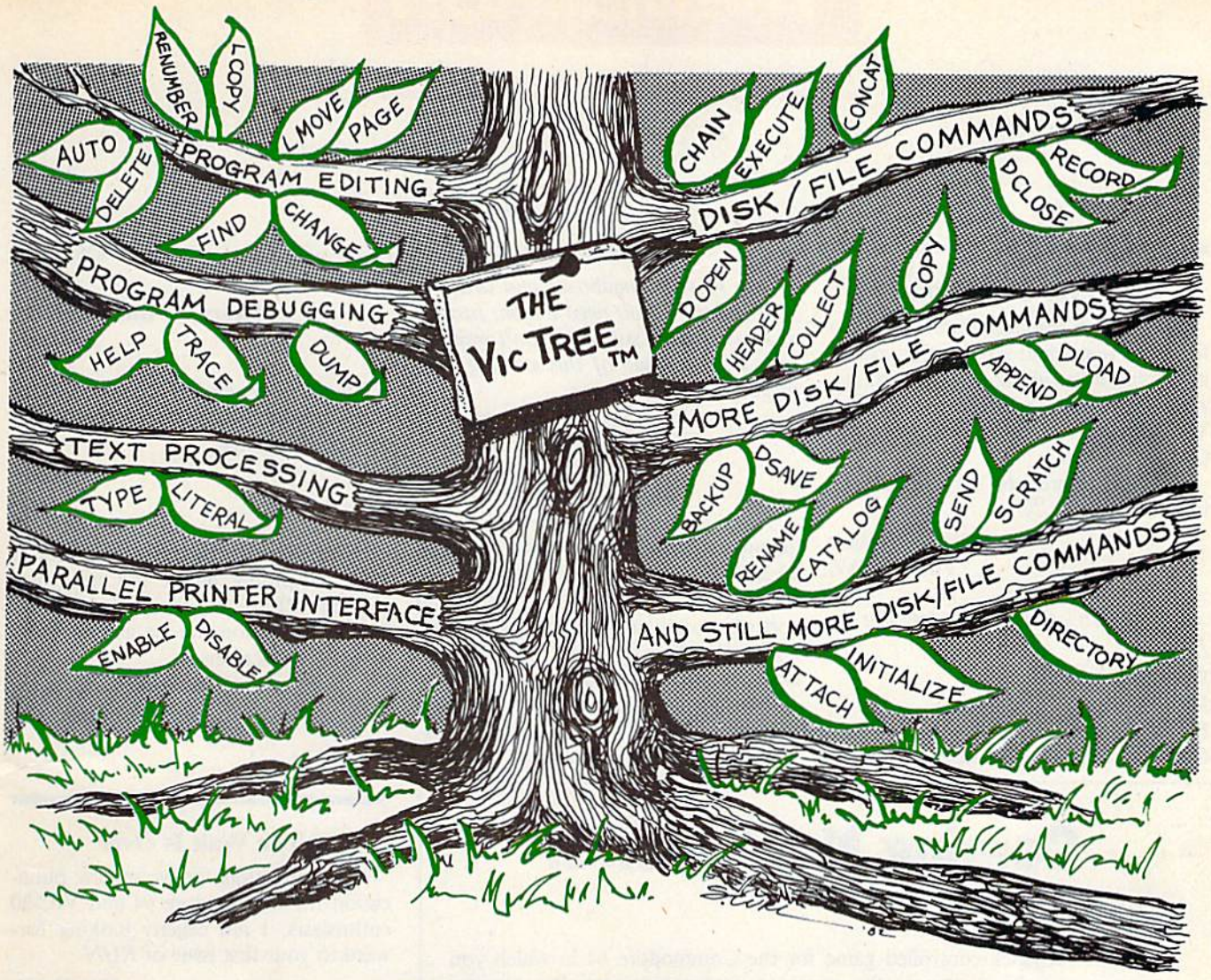

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The Mail RUN

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Michael Stubler
Phoenix, AZ

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Editors

As a subscriber to your *Microcomputing* magazine, I loved the quality and objectivity of the articles. But as a Commodore 64 system owner, I was feeling sort of shortchanged for my $25, especially in the light of all the new Commodore computer-oriented magazines.

With your announcement of the formation of the *RUN* computer magazine—Commodore systems oriented—I wish to send to you $25 for a Charter Subscription.

Henry C. Armbruster, Jr.
Lisle, IL

Thank you, sir. We think you've made a wise investment...and here's your $5.03 change.

Editors

I just finished reading your notice in *Microcomputing* about the new, upcoming VIC/C-64 magazine, *RUN*. Please put me on the list as one of its premiere subscribers.

Mike Del Selva
San Mateo, CA

Coming Next Month

GAMES...

Mosquito—Joystick-controlled game for the Commodore 64 in which you maneuver a fly swatter on the screen to swat a mosquito. But beware, these mosquitoes are relentless; insect repellent won't stop them.

VIC Gallery—Step right up and test your mettle in this shootin' gallery game for the VIC-20.

UTILITIES...

Defining Function Keys—This handy utility lets you assign functions to the VIC-20's function keys and executes any function with a single keystroke.

Simplifying Sprite Graphics—This program lets you take advantage of the graphics capability on the Commodore 64.

SPECIAL FEATURES...

Beginner's Guide to the 1541 Disk Drive—A simple, step-by-step explanation of how to get the most out of your disk drive. Includes a discussion of the most frequently used 1541 features and operations.

Program of the Month—A "mini" database program for the Commodore 64 and VIC-20. If sold on the software market, it would easily be worth $20–$30. Available FREE to the readers of the Feb. issue of *RUN*.

COLUMNS...

—Louis Sander's "Magic" collection of hints, tricks and odds and ends features useful computer tips.

—David Busch's monthly column on game programming features a graphics program entitled "Draw" that lets you draw on the VIC-20 screen in full color.

—Also, the Beyond the Manual series on how to write your own programs continues.

The Wait Is Over

Congratulations on your new publication for Commodore 64 and VIC-20 enthusiasts. I am eagerly looking forward to your first issue of *RUN*.

Ken Coach
New York, NY

I look forward to the appearance of your magazine, *RUN*, and am sure that it will be a success, just like the rest of the Wayne Green publications.

Edgar F. Coudal
Park Ridge, IL

RUN to the Top

It is our sincere belief that *RUN* Magazine could quickly become the leader in the Commodore-specialty publications field. We will gladly work with you in achieving this goal.

Julie Knott and Dave Prochnow
Bellevue, NE

We humbly share your optimism.

Editors

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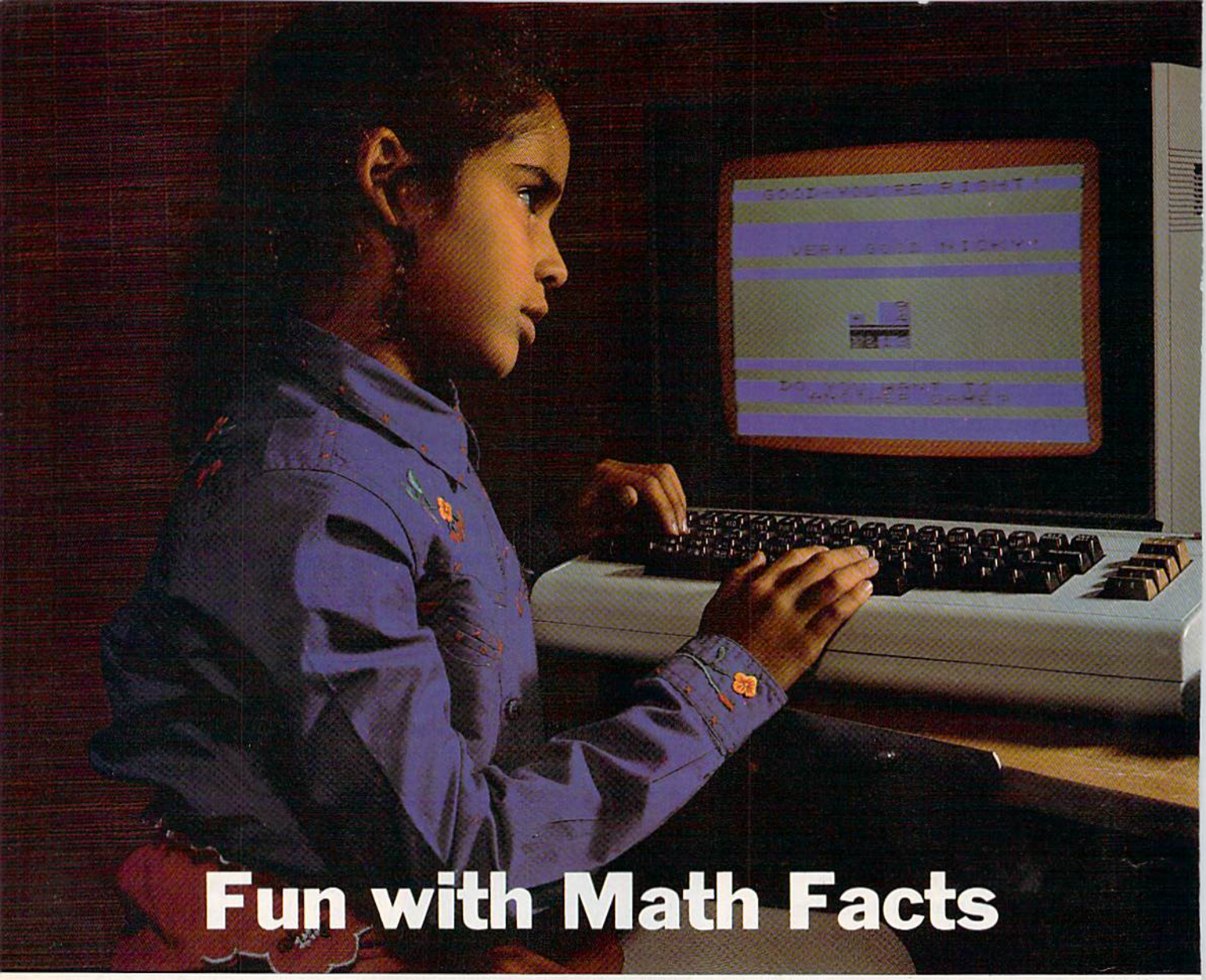

Fun with Math Facts

Here is a simple program that uses the features of the VIC-20 or Commodore 64 (screen display, colors, timing and sound) to reinforce math learned in the primary grades.

By Don Jacobs

RUN It Right

Unexpanded VIC-20 or Commodore 64

Address author correspondence to Don Jacobs, Department of Physics, The College of Wooster, Wooster, OH 44691.

At a time when the National Science Foundation, the National Academy of Sciences, President Reagan and many others are encouraging better math and science training, the public school systems in many areas just don't have the money to improve their programs. With the schools unable to beef up curricula, more education will need to take place in the home, a fact recognized by many who have bought home computers.

The routine in Mathquiz, a program written to run on a basic VIC-20 without any memory expansion, is an enhancement of the old-fashioned flash cards, which check a child's ability to add, subtract or multiply. By providing not only problems whose answers are usually memorized, but also ones that must be calculated, the program extends and reinforces those mathematical techniques learned in grades 1–4.

Three levels of difficulty (1, 2 or 3) are possible for each math operation, with level 1 being the easiest. These levels correspond to one-, two- or three-digit addition or subtraction. For multiplication, the levels correspond to the product of two one-digit numbers, a two-digit number by a one-digit number, or a three-digit number by a two-digit number divisible by ten.

The program randomly chooses each of the two numbers according to the level chosen, but prevents a negative result when subtracting. If the answer typed in by the student is incorrect, the program provides both a note and the correct solution. The student has a fixed time interval to work on each problem, with more time allowed for the harder problems. If the student runs out of time, a chirping sound directs the student to the screen, where the correct solution appears.

Sound of Music

At the end of ten problems, the stu-

Listing 1. The Mathquiz program for the VIC-20.

```
1 REM MATHQUIZ FOR VIC       BY DON JACOBS
2 CL=6:REM COLOR OF NUMBERS
5 DEF FNL(X)=X+22*R+C-PP
10 S2=36875:V=S2+3:S4=S2+2
30 GOTO900
99 REM SONG
100 POKE V,15
102 IFCA-6<=0THEN210:REM AMOUNT OF SONG DEPENDS ON SCOR
    E
103 REM IF NOTE=-1 THEN STOP
105 READ P:IF P=-1 THEN202
120 READ D:POKE S2,P
160 FOR N=1TO150*D:NEXTN:REM CHANGE 150 FOR TEMPO
170 POKE S2,0:FORN=1TO20:NEXTN
190 GOTO105
202 CA=CA-1:GOTO102
210 POKE V,0:RESTORE:GOTO1600
299 REM PITCH,BEATS
300 DATA183,2,195,1,215,3,209,2,195,1,187,3
310 DATA183,2,183,1,183,1,187,1,195,1,201,3,195,3,-1
320 DATA183,2,195,1,215,3,209,2,195,1
340 DATA187,3,183,2,195,1,195,1,201,1,207,1,209,3,209,3
    ,-1
350 DATA215,1.5,195,0.5,195,1,207,1,201,1,195,1,183,2
360 DATA195,1,209,3,201,2,209,1,215,2,209,1
370 DATA207,3,195,3,-1,183,2,195,1,215,3,209,2,195,1
380 DATA187,3,183,2,195,1,195,1,201,1,207,1,209,3,209,3
    ,-1
900 PRINT"[SHFT CLR]":PRINT" ADDITION=A":PRINT" SUBTRAC
    TION=S"
905 PRINT" MULTIPLICATION=M":PRINT" CHOICE?"
910 GETL$:IFL$=""THEN910
920 IFL$="S"THEN CH=-1:GOTO1000
930 IFL$="A"THEN CH=1:GOTO1000
940 IFL$="M"THEN CH=0:GOTO1000
950 GOTO900
1000 PRINT"[SHFT CLR]":PRINT"LEVEL OF DIFFICULTY?":PRIN
     T"1,2,OR 3;"PRINT"(1 IS EASIER)":PRINT"CHOICE?"
1010 GETL$:IFL$=""THEN1010
1020 IFL$<"1" OR L$>"3"THEN1010
1030 F=10[UP ARROW](VAL(L$)-1)
1060 CA=0:FORII=1TO10:PRINT"[SHFT CLR]"
1070 K=INT(RND(1)*F*10):REM CHOOSE PROBLEM
1074 F1=F
1075 IFCH=0ANDF>1THENF1=F/10
1080 L=INT(RND(1)*F1*10)
1090 ON CH+1GOTO1110,1120
1100 SN=45:IFL>KTHEN1070:REM NON-NEG SUB ANS
1105 ANS=K-L:GOTO1130
1110 SN=24:IF INT(L/10)=0 OR INT(L/10)=L/10 THEN1118
1112 GOTO1080
1118 ANS=K*L:IFINT(ANS/10000)>0THEN1080
1119 GOTO1130
1120 SN=43:ANS=K+L
1130 K$=STR$(K):L$=STR$(L):LI$="[SHFT D][SHFT D][SHFT D
     ][SHFT D]":LJ$="[COMD +][COMD +][COMD +][COMD +]":
     REM PUT PROB ON SCREEN
1140 R=6:C=11:Z$=K$:GOSUB3000
1150 R=R+1:Z$=L$:GOSUB3000
1160 C=C-LEN(L$)-1:PP=0:POKEFNL(7680),SN:POKEFNL(38400)
     ,CL
1170 R=R+1:C=11:Z$=LI$:GOSUB3000
1180 R=R+1:Z$=LJ$:GOSUB3000
1190 MM=7680+22*R+C
1200 Z1=INT(TI/100)
1210 GOSUB2210
1220 IFZIP=1THEN2000:REM OUT OF TIME
1230 POKEMM,ASC(AZ$):MM=MM-1:AP=VAL(AZ$)
1250 IFLEN(STR$(ANS))<3THEN1440
1260 GOSUB2210:IFZIP=1THEN2000
```

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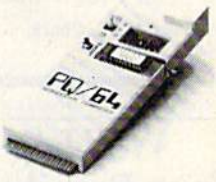

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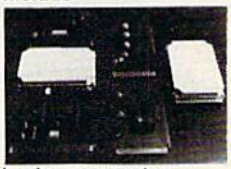

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Listing 1 continued.

```
1265 IFZAP=1THEN1210
1270 POKEMM,ASC(AZ$):MM=MM-1:AP=AP+10*VAL(AZ$)
1280 IFLEN(STR$(ANS))<4THEN1440
1290 GOSUB2210:IFZIP=1THEN2000
1295 IFZAP=1THEN1260
1300 POKEMM,ASC(AZ$):MM=MM-1:AP=AP+100*VAL(AZ$)
1310 IFLEN(STR$(ANS))<5THEN1440
1320 GOSUB2210:IFZIP=1THEN2000
1325 IFZAP=1THEN1290
1330 POKEMM,ASC(AZ$):AP=AP+1000*VAL(AZ$)
1440 IFAP=ANSTHENPRINT"  GOOD-YOU'RE RIGHT!":CA=CA+1:GO
     TO1490
1450 PRINT" NO-THE ANSWER IS";ANS
1490 FORDL=1TO750:GETL$:NEXTDL,II
1500 PRINT"[SHFT CLR]": PRINT" YOU WERE RIGHT":PRINT" "
     ;CA;" OUT OF 10 TIMES"
1505 IFCA<4THENCA=4
1510 ONCA-4GOTO1530,1540,1550,1560,1570,1580
1520 PRINT:PRINT"BE SURE TO PLACE ","THE NUMBER WHERE T
     HE","BLINKING SYMBOL IS"
1525 GOTO 1600
1530 PRINT:PRINT" OK--TRY SOME MORE!!":GOTO1600
1540 PRINT:PRINT" GOOD--TRY SOME MORE!!":GOTO1600
1550 PRINT:PRINT" VERY GOOD--":PRINT"TRY SOME MORE!!":G
     OTO100
1560 PRINT:PRINT" EXCELLENT--":PRINT"TRY SOME MORE!!":G
     OTO100
1570 PRINT:PRINT" FABULOUS--":PRINT"TRY SOME MORE!!":GO
     TO100
1580 PRINT:PRINT" SUPER!!!--":PRINT"TRY SOME MORE!!":GO
     TO100
1600 PRINT:PRINT"WANT MORE? (Y OR N)"
1610 GETD$:IFD$=""THEN1610
1620 IFD$="Y"THEN900
1630 END
2000 PRINT" OUT OF TIME":PRINT"  ANSWER WAS ";ANS
2010 POKES4,250:POKEV,15:FORJJ=1TO50:NEXTJJ:POKES4,0:PO
     KEV,0:GOTO1490
2210 ZIP=0:ZAP=0:GETAZ$:IFINT(TI/100)>Z1+5*FTHEN2250
2215 KK=KK+1:IFKK/2=INT(KK/2)THENPOKEMM,70:GOTO2220
2217 POKEMM,102
2220 IFAZ$=""THEN2210
2222 IFASC(AZ$)=136THENCL=CL+1:REM CHANGE COLOR
2223 IFCL<2ORCL>=8THENCL=2
2224 REM ERASE
2225 IFASC(AZ$)=29THENMM=MM+1:AP=AP-10[UP ARROW](7889-M
     M)*(PEEK(MM)-48):ZAP=1:RETURN
2230 IFASC(AZ$)<48 OR ASC(AZ$)>57THEN2210
2240 RETURN
2250 ZIP=1:RETURN
3000 FORPP=0TOLEN(Z$)-1:POKEFNL(7680),ASC(MID$(Z$,LEN(Z
     $)-PP,1))
3010 POKEFNL(38400),CL:NEXTPP:RETURN
```

Listing 2. The Mathquiz program for the C-64.

```
1 REM MATHQUIZ FOR C-64      BY DON JACOBS
2 CL=1:REM COLOR OF NUMBERS
5 DEF FNL(X)=X+40*R+C-PP
10 S1=54277:S2=54276:S3=54273:S4=54272:V=54296
30 GOTO900
99 REM SONG
100 POKEV,15:POKES1,9
102 IFCA-6<=0THEN210:REM AMOUNT OF SONG DEPENDS ON SCOR
    E
103 REM IF NOTE=-1 THEN STOP
105 READ P:IF P=-1 THEN202
120 READPP,D:POKES3,P:POKES4,PP:POKES2,17
```

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dent's score appears on the screen, along with a musical reward. The song in the program is a favorite of my daughter Kathy, but any song can be substituted. This part of the program (lines 100–210) is from the VIC-20 manual. The song (lines 300–380) is divided into four parts (separated by a −1), with the entire song being played for a perfect score. For each question missed, less of the song is played, thus providing incentive to get all the questions right.

When running, the program asks for the math operation (addition, subtraction or multiplication), followed by the level of difficulty (1, 2 or 3). It then presents the problem on the screen vertically and places the cursor under the rightmost digit for the result of that column. The cursor then moves to the left until all the digits are entered.

Learning was never so much fun with Mathquiz.

Thus, nine plus five would be answered by typing a four followed by a one. The result is entered from the right to the left to simulate the process used when writing the problem on paper, and is essential when working multidigit problems whose answers have not been memorized. An "eraser" is provided to allow the cursor to be moved to change a number. In the example above, if a one were typed first, it could be erased by hitting the right cursor key, and a new number could then be entered.

Of course, such corrections come out of the allotted time per problem, as discussed above. The color of the next problem can be changed by pressing the f 7 key, should the student's interest wane. The song may also be changed, preferably by the ingenuity of the student.

Listing 1 shows the program for the VIC-20. The program that will run on a Commodore 64 appears in Listing 2. For those who want to save some typing, a copy with the VIC-20 on one side and the Commodore 64 on the other may be obtained from the author for $5, or will be provided free if you send a blank cassette tape. Your children will enjoy "playing on the computer" while they reinforce their math skills with this program. R

Listing 2 continued.

```
160 FOR N=1TO100*D:NEXTN:REM CHANGE 150 FOR TEMPO
170 POKES2,16:FORN=1TO20:NEXTN
190 GOTO105
202 CA=CA-1:GOTO102
210 POKE V,0:RESTORE:GOTO1600
299 REM PITCH,BEATS
300 DATA14,24,2,16,195,1,25,30,3,22,96,2,16,195,1,14,23
    9,3
310 DATA14,24,2,14,24,1,14,24,1,14,239,1,16,195,1,18,20
    9,3,16,195,3,-1
320 DATA14,24,2,16,195,1,25,30,3,22,96,2,16,195,1,14,23
    9,3
340 DATA14,24,2,16,195,1,16,195,1,18,209,1,21,31,1,22,9
    6,3,22,96,3,-1
350 DATA25,30,1.5,16,195,.5,16,195,1,21,31,1,18,209,1,1
    6,195,1,14,24,2
360 DATA16,195,1,22,96,3,18,209,2,22,96,1,25,30,2,22,96
    ,1,21,31,3,16,195,3,-1
370 DATA14,24,2,16,195,1,25,30,3,22,96,2,16,195,1,14,23
    9,3
380 DATA14,24,2,16,195,1,16,195,1,18,209,1,21,31,1,22,9
    6,3,22,96,3,-1
900 PRINT"[SHFT CLR]":PRINT" ADDITION=A":PRINT" SUBTRAC
    TION=S"
905 PRINT" MULTIPLICATION=M":PRINT" CHOICE?"
910 GETL$:IFL$=""THEN910
920 IFL$="S"THEN CH=-1:GOTO1000
930 IFL$="A"THEN CH=1:GOTO1000
940 IFL$="M"THEN CH=0:GOTO1000
950 GOTO900
1000 PRINT"[SHFT CLR]":PRINT"LEVEL OF DIFFICULTY?":PRIN
     T"1,2,OR 3;";
1005 PRINT" (1 IS EASIER)","CHOICE?"
1010 GETL$:IFL$=""THEN1010
1020 IFL$<"1" OR L$>"3"THEN1010
1030 F=10[UP ARROW](VAL(L$)-1)
1060 CA=0:FORII=1TO10:PRINT"[SHFT CLR]"
1070 K=INT(RND(1)*F*10):REM CHOOSE PROBLEM
1074 F1=F
1075 IFCH=0ANDF>1THENF1=F/10
1080 L=INT(RND(1)*F1*10)
1090 ON CH+1GOTO1110,1120
1100 SN=45:IFL>KTHEN1070:REM NON-NEG SUB ANS
1105 ANS=K-L:GOTO1130
1110 SN=24:IF INT(L/10)=0 OR INT(L/10)=L/10 THEN1118
1112 GOTO1080
1118 ANS=K*L:IFINT(ANS/10000)>0THEN1080
1119 GOTO1130
1120 SN=43:ANS=K+L
1130 K$=STR$(K):L$=STR$(L):LI$="[SHFT D][SHFT D][SHFT D
     ][SHFT D]":LJ$="[COMD +][COMD +][COMD +][COMD +]":
     REM PUT PROB ON SCREEN
1140 R=6:C=11:Z$=K$:GOSUB3000
1150 R=R+1:Z$=L$:GOSUB3000
1160 C=C-LEN(L$)-1:PP=0:POKEFNL(1024),SN:POKEFNL(55296)
     ,CL
1170 R=R+1:C=11:Z$=LI$:GOSUB3000
1180 R=R+1:Z$=LJ$:GOSUB3000
1190 MM=1024+40*R+C
1200 Z1=INT(TI/100)
1210 GOSUB2210
1220 IFZIP=1THEN2000:REM OUT OF TIME
1230 POKEMM,ASC(AZ$):MM=MM-1
1240 AP=VAL(AZ$)
1250 IFLEN(STR$(ANS))<3THEN1440
1260 GOSUB2210:IFZIP=1THEN2000
1265 IFZAP=1THEN1210
1270 POKEMM,ASC(AZ$):MM=MM-1:AP=AP+10*VAL(AZ$)
1280 IFLEN(STR$(ANS))<4THEN1440
1290 GOSUB2210:IFZIP=1THEN2000
1295 IFZAP=1THEN1260
1300 POKEMM,ASC(AZ$):MM=MM-1:AP=AP+100*VAL(AZ$)
1310 IFLEN(STR$(ANS))<5THEN1440
```

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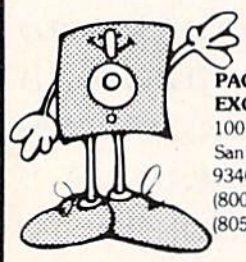

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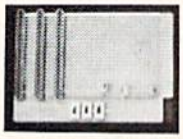

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Listing 2 continued.

```
1320 GOSUB2210:IFZIP=1THEN2000
1325 IFZAP=1THEN1290
1330 POKEMM,ASC(AZ$)
1335 AP=AP+1000*VAL(AZ$)
1440 IFAP=ANSTHENPRINT"  GOOD-YOU'RE RIGHT!":CA=CA+1:GO
     TO1490
1450 PRINT" NO-THE ANSWER IS";ANS
1490 FORDL=1TO750:GETL$:NEXTDL,II
1500 PRINT"[SHFT CLR]": PRINT" YOU WERE RIGHT":PRINT" "
     ;CA;" OUT OF 10 TIMES"
1505 IFCA<4THENCA=4
1510 ONCA-4GOTO1530,1540,1550,1560,1570,1580
1520 PRINT
1521 PRINT"BE SURE TO PLACE ","THE NUMBER WHERE THE","
     BLINKING SYMBOL IS"
1522 GOTO1600
1530 PRINT:PRINT" OK--TRY SOME MORE!!":GOTO1600
1540 PRINT:PRINT" GOOD--TRY SOME MORE!!":GOTO1600
1550 PRINT:PRINT" VERY GOOD--":PRINT"TRY SOME MORE!!":G
     OTO100
1560 PRINT:PRINT" EXCELLENT--":PRINT"TRY SOME MORE!!":G
     OTO100
1570 PRINT:PRINT" FABULOUS--":PRINT"TRY SOME MORE!!":GO
     TO100
1580 PRINT:PRINT" SUPER!!!--":PRINT"TRY SOME MORE!!":GO
     TO100
1600 PRINT:PRINT"WANT MORE? (Y OR N)"
1610 GETD$:IFD$=""THEN1610
1620 IFD$="Y"THEN900
1630 END
2000 PRINT" OUT OF TIME":PRINT"  ANSWER WAS ";ANS
2010 FORN=15TOOSTEP-1:POKEV,N:POKES2,129:POKES1,15:POKE
     S3,40:POKES4,200:NEXTN
2020 POKES2,0:POKES1,0:GOTO1490
2210 ZIP=0:ZAP=0:GETAZ$:IFINT(TI/100)>Z1+5*FTHEN2250
2215 KK=KK+1:IFKK/2=INT(KK/2)THENPOKEMM,70:GOTO2220
2217 POKEMM,102
2220 IFAZ$=""THEN2210
2222 IFASC(AZ$)=136THENCL=CL+1:IFCL=6THENCL=CL+1 :REM C
     HANGE COLOR
2223 IFCL<20RCL>=8THENCL=1
2224 REM ERASE
2225 IFASC(AZ$)=29THENMM=MM+1:AP=AP-10[UP ARROW](1395-M
     M)*(PEEK(MM)-48):ZAP=1:RETURN
2230 IFASC(AZ$)<48 OR ASC(AZ$)>57THEN2210
2240 RETURN
2250 ZIP=1:RETURN
3000 FORPP=0TOLEN(Z$)-1:POKEFNL(1024),ASC(MID$(Z$,LEN(Z
     $)-PP,1))
3010 POKEFNL(55296),CL:NEXTPP:RETURN
```

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By Gary D. McClellan

RUN It Right

Commodore 64
Joystick

Address author correspondence to Gary D. McClellan, PO Box 346, Rimrock, AZ 86335.

Enjoyable games can be created in Basic using the C-64's sprite graphics capability—without the need for writing routines in assembly language. The simple process for generating such a game can be broken down into three general steps:

1. Define the scenario and what action will take place.
2. Create the graphics images necessary to complete the scenario.
3. Write the program.

Scenario

Writing a game program is similar to writing a short story; the background and setting are important. Since I've always been fond of lunar-lander-type games, I decided a lander game using sprite graphics would be fun to write. I wanted a different setting than Earth's moon, however, so I decided on the following scenario.

Zelaz is an airless planetoid discovered in 2183. Mineral deposits of commercial quantity were located in the northern hemisphere. The first three landing parties perished when their ships were destroyed at landing. Fluxes in the planetoid's magnetic field were discovered, and a landing team was sent in farther south.

After a successful landing, the team moved north with tracked vehicles. Rich deposits of Ellisonite were discovered. Mining operations began and the excavations followed the Ellisonite plugs down through the crystalline mantle of Zelaz.

The aberrations in the magnetic field stabilized below the surface of Zelaz, so the miners nicknamed the destructive forces at the top of the canyons the "magwinds." A warning beacon was erected at the top of each canyon wall to warn of the danger. Other problems occurred.

The crystalline layer surrounding the deposits of Ellisonite reacted violently to earth-manufactured alloys. To protect their equipment and themselves from serious damage, the miners left a thin coating of Ellisonite covering the canyon sides as a buffer zone. A heavily shielded shuttle was built to haul loads of Ellisonite from the bottom of the subcanyons created by the mining operation to the landing pad at the upper level of the main canyon.

Action

The mission of the shuttle pilot is to fly into each subcanyon and to land successfully at the bottom. At each of three landing pads in the canyons, the shuttle drops off mail and supplies for the mining team working there and takes on a cargo of Ellisonite and 300 units of fuel. The shuttle then must be flown to the next landing pad or return to the upper landing pad, where greater supplies of fuel are available.

If the shuttle makes contact with a landing pad at a velocity of −10 or less

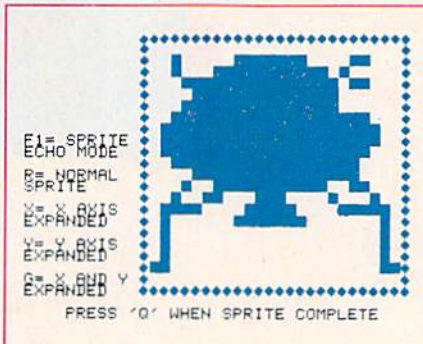


Fig. 1. Screen dump of sprite utility program with shuttle sprite displayed.

or a horizontal velocity of 4.5 or greater or −4.5 or less, the shuttle will explode. If the shuttle brushes against the canyon walls briefly, nothing will happen. More than brief contact will explode the ship.

When the shuttle is returning to the upper pad, if the shuttle altitude reaches the same altitude of the warning beacons, the shuttle will be ripped apart by the magwinds or hurled into the upper canyon walls.

After all three lower landing pads have been reached and the shuttle has safely returned to the upper pad, the mission is complete. A status report will be generated on the mission computer and the shuttle pilot scored.

Graphics

To complete the scenario, the graphics images required were made up of a shuttle craft, landing pads and the canyon.

The shuttle craft is a perfect candidate for sprite graphics, since a complete graphics image needs to be moved around the screen rather quickly. The image of the shuttle (see Fig. 1) was created using the sprite utility program for the C-64 from the June 1983 issue of *Microcomputing*. The shuttle craft image then was edited to add a rocket exhaust (see Fig. 2). The 63-byte data description for each image was displayed and then entered into data statements in the game program (see Figs. 3 and 4).

Since the shuttle would be interacting with the landing pads, a sprite image of a pad was created. This was done by filling the first 24 bytes of the 63-byte image with decimal value 255. The resulting graphics image is a solid block, eight pixels deep by 24 pixels wide.

The canyon was created by poking values for the C-64's low-resolution graphics characters into screen memory.

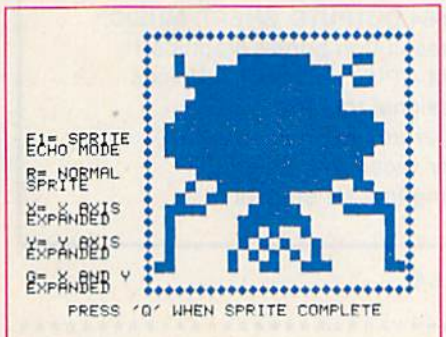
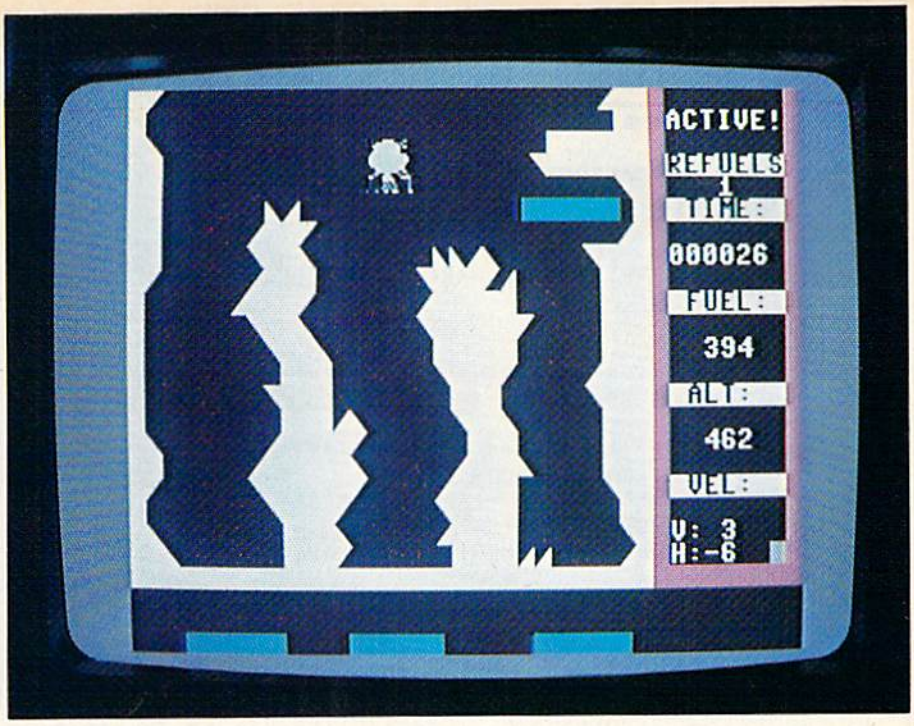


Fig. 2. Shuttle sprite in Fig. 1 edited to add rocket exhaust to sprite image.



Program Description

After defining the scenario and creating the graphics images to go along with it, you'll write the program. In the debugging process, you'll discard a few ideas and find others that will modify the scenario and the graphics. The creative process continues until you're satisfied with the results.

In the completed game program, let's look at the beginning lines, then at the various subroutines and finally at the main program loop to see how we can animate the sprite images to obtain the results we need.

Lines 5–30: The program clears the screen in line 5 and then prints the starting message.

Line 60: Line 60 sets up the game before the program enters the main loop at line 100. The variable 0F is an offset value between the standard screen memory starting at location 1024 and screen color memory starting at location 55296. Anytime a value is stored into screen memory, the color can be set by storing a color value into SCREEN LOCATION + 0F.

Subroutines at line 500 and line 900 are called to draw the background for the game; they enable the sound generator and sprite graphics.

Lines 500–597: The routine at line 500 generates the game background and

```
BYTE 1     0       0       0
BYTE 4     32      254     24
BYTE 7     35      255     160
BYTE 10    31      255     216
BYTE 13    15      255     192
BYTE 16    31      255     192
BYTE 19    63      255     248
BYTE 22    127     255     252
BYTE 25    127     255     252
BYTE 28    127     255     248
BYTE 31    63      255     240
BYTE 34    15      255     240
BYTE 37    19      255     152
BYTE 40    38      56      68
BYTE 43    120     124     62
BYTE 46    64      254     2
BYTE 49    64      0       2
BYTE 52    64      0       2
BYTE 55    64      0       2
BYTE 58    192     0       3
BYTE 61    0       0       0
ENTER ANY CHARACTER FOR MENU.
?
```

Fig. 3. Sixty-three-byte data description of shuttle sprite displayed in Fig. 1.

```
BYTE 1     0       0       0
BYTE 4     32      254     24
BYTE 7     35      255     160
BYTE 10    31      255     216
BYTE 13    15      255     192
BYTE 16    31      255     192
BYTE 19    63      255     248
BYTE 22    127     255     252
BYTE 25    127     255     252
BYTE 28    127     255     248
BYTE 31    63      255     240
BYTE 34    15      255     240
BYTE 37    19      255     152
BYTE 40    38      56      68
BYTE 43    120     124     62
BYTE 46    64      254     2
BYTE 49    64      210     2
BYTE 52    64      169     2
BYTE 55    65      85      2
BYTE 58    193     51      131
BYTE 61    0       0       0
ENTER ANY CHARACTER FOR MENU.
?
```

Fig. 4. Sixty-three-byte data description of shuttle sprite with exhaust displayed in Fig. 2.

Listing 1. Canyons of Zelaz game program.

```
5 PRINTCHR$(147)
10 PRINT"****************************************"
12 PRINT"*                                      *"
14 PRINT"*     CANYONS OF ZELAZ                 *"
16 PRINT"*                                      *"
18 PRINT"*                                      *"
20 PRINT"*                                      *"
22 PRINT"*     WRITTEN BY GARY D MCCLELLAN      *"
24 PRINT"*                                      *"
26 PRINT"*                                      *"
28 PRINT"*                                      *"
30 PRINT"****************************************"
60 OF=54272:GOSUB500:GOSUB900:TI$="000000":FF=16:Y=71:P
   OKEV+1,Y:GOSUB400
97 REM*********************************
98 REM*   MAIN PROGRAM LOOP           *
99 REM*********************************
100 CS=0:CP=0:POKEV+31,0:J=PEEK(56320)
105 IF(JAND16)OR(FU<1)THENC1=-9:POKEAD,0:POKEWA,0:GOTO1
    50
107 POKE54296,15:POKEAD,88:POKESR,240:POKEWA,129:FU=FU-
    3.5:C1=5.5:POKE2040,14
110 IFNOTJAND8THENX1=X1+.25:FU=FU-.5
112 IFNOTJAND4THENX1=X1-.25:FU=FU-.5
113 IFNOTJAND1THENFU=FU+1.75:C1=32
150 POKE55296,2:POKE55326,2:C2=64/C1:V2=V1-.4+.2*C2:A2=
    A2+.1*(V1+V2):V1=V2
155 CP=PEEK(V+31)AND1:IFCP=0THENCR=0
176 Y=(222-INT(A2/D)):X=X+X1:IFY<55THENX1=X1*2
177 IFX<10RX>254ORY<45THENGOSUB300
178 POKE53279,0:POKEV,X:POKEV+1,Y:IFPEEK(53279)AND1THEN
    CR=CR+1:IFCR>1THENCS=1
```

More →

mission computer display and loads the sprite images into memory. Data values are read from the data statements beginning at line 1000 and stored into three 64-byte sections of memory.

A sprite is defined by 63 bytes of data, but the 64th byte is used by the C-64 as a control byte for each image. The C-64 is set up to handle up to eight sprite images at a time, so a value has to be assigned to each sprite image defined. This value is the number of the memory section in which the sprite image is stored. The sprite images defined by the data statements are stored in memory sections 13, 14 and 15 ($13 \times 64 = 832$, the starting address at which the data is stored).

After the values in the data statements have been read and stored into memory, we have three sprite image definitions we can use. The landing pad image is in section 13, the shuttle image in section 14, and the shuttle with exhaust is in section 15.

Line 504 dimensions a string array and creates four elements of the array that will be used in the mission status report.

Line 506 clears the screen, and then sets the screen background color to

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dark gray and the screen border color to light gray. The For...Next loop fills screen color memory with the value for the color white.

Lines 508–510 draw the border for the mission computer on the right-hand side of the screen and color the border an off-world purple.

Lines 512–577 draw the game background on the screen. Since color memory already has been filled with white, the character graphics poked to the screen will appear as white objects against a dark gray background.

Lines 584 to 597 draw the instrument readouts for the mission computer on the screen.

Lines 900–950: This subroutine enables the sprite images previously placed in memory and initializes the sound generator.

In line 900, the starting address of the C-64 video controller is set to variable V. Variable X is loaded with the beginning X-axis coordinate for the shuttle. The variable Y is loaded with the beginning Y-axis coordinate for the shuttle. Variable D is set to 3 and used in the main program loop to calculate altitude. Memory location V+31 contains the sprite-to-background collision register and is initialized to 0. Variable A2 is the starting altitude of the shuttle when the game begins, and variable FU will be used to count the number of times the shuttle refuels during the game.

Images Enabled

Sprite images are enabled for use by setting from one to eight bit values to 1 in the sprite-enable register at location V+21. Setting a bit to 1 will turn on a sprite. The first bit in the register is sprite 0, the second bit enables sprite 1, and so on (bit 0 is also the first bit in a byte). By poking the value 31 into the enable register, we set bits 0 through 4 to 1, and enable five sprites.

The C-64 needs a way to determine which sprite image will be used by an enabled sprite. Eight locations at the end of screen memory have been reserved for this function. Memory locations 2040–2047 correspond to sprites 0–7. By poking the value 15 into location 2040, we define the sprite image at section 15 as sprite 0.

At this point, five sprites have been enabled and sprite 0 has been defined. Sprites are positioned on the screen by loading an X and Y coordinate into the sprite position registers at locations V through V+15. The X coordinate for sprite 0 is at location V. The Y coordinate for sprite 0 is at location V+1.

Now that the shuttle is enabled, de-

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fined and positioned on the screen, a value of 1 is poked into location V+27. This location is the sprite/background priority register. By setting bit 0 (which represents sprite 0) to 1, the shuttle sprite will disappear "behind" any low-resolution graphics characters it encounters on the screen.

Sprites 1–4 are defined as the sprite image in section 13 in line 916. This is the landing pad image. Since we need four landing pads, we can define four different sprites using the same basic image. The X and Y coordinates for the four landing pad sprites are set in line 918.

Memory locations V+39 through V+46 contain color registers for sprites 0–7. Line 920 pokes the value for light gray into the register for the shuttle, and pokes the value for green into the registers for the landing pad sprites. Line 92 sets bits 1, 2, 3 and 4 to 1 in sprite expand X register at location V+29. This doubles the horizontal size of the landing pads.

Locations V+37 and V+38 are two extra color registers used with multicolor sprites. These two locations are loaded with the value for yellow and red and will be used by the shuttle crash routine.

Line 930 sets the registers of the sound generator to 0 with a For...Next loop and then defines variables for waveform, attack/decay, sustain/release, note frequency low and note frequency high. The high- and low- frequency values for a note are then poked into the registers at line 940.

Lines 300–395: The mission report routine consists of three separate subroutines that are called when a shuttle crash occurs, a mission abort is requested or the mission is successfully completed.

The routine is entered at line 300 in a crash sequence. Line 300 stores note values in memory and then sets the volume control register at location 54296 to high. Attack/decay, sustain/release and waveform are loaded with values, and the noise begins.

The variable CK is the crash flag and is set to 1. In line 304, the sprite image for sprite 0 (this previously was the shuttle) is defined as memory section 11, a blank section of memory. A value of 1 is poked into the multicolor sprite select register at location V+28. Sprite 0 is now a multicolor sprite.

Fireworks

The explosion begins in line 305. The subroutine at line 380, which fills 25 random locations in memory section 11 with random values, is called. Sprite 0 is then expanded on the X axis, and subroutine 380 is called again to add more random multicolor points to sprite 0.

Sprite 0 is then expanded on its Y axis, and once again subroutine 380 is called to provide a changing color effect. The explosion is complete and the subroutine at line 390 is called to clear memory section 11 for later use. Line 310 turns off the noise and the explosion is over.

The mission report status is printed in line 315, and line 317 tidies up the registers by clearing the expanded X and Y coordinates of sprite 0. This disables sprite 0 in the enable register and turns off the multicolor mode. The program then goes to line 370 and samples joystick port 2 for input. If the fire button is pressed, the program reinitializes and returns to the calling routine. If the joystick handle is pulled down and the fire button pressed, the program turns off the sprites; clears the screen, variables and pointers; and ends the program.

Line 350 is the mission-abort routine. The mission status is printed, and then the program goes to line 370 to wait for joystick input to restart or end the program.

Lines 360–363 make up the mission-complete routine. A score is calculated for the mission based on the number of refueling stops, and a mission report is then displayed. The program executes the routine at line 370 and restarts or ends the program.

Lines 400–496: The shuttle/pad collision routine is called whenever the shuttle sprite is in physical contact with a landing pad sprite. When this occurs, if the vertical velocity is less than −10 or the horizontal velocity is greater than 4.5 or less than −4.5, line 400 calls the crash subroutine at line 300. Line 403 checks if the shuttle has touched the upper landing pad, and calls the crash routine at line 300 if the shuttle is not lined up on the pad.

At line 405, the shuttle has not met the crash requirements, so we have a successful landing. A mission-status message is displayed, the shuttle sprite is defined as the image without exhaust, and noise from the rocket is turned off.

If the shuttle has landed on the upper landing pad, line 410 checks to see if all

Listing 1 continued.

```
180 PRINTH$P$P$P$CHR$(17)TAB(32)TI$:PRINTP$TAB(33)STR$(
    INT(FU))+" "
185 PRINTP$TAB(33)STR$(INT(A2))+" ":PRINTP$TAB(32)"V:"S
    TR$(INT(V2))+" "
186 HV$=STR$(X1*3)+"    ":PRINTTAB(32)"H:"LEFT$(HV$,5)
190 FF=PEEK(V+30)AND30:IFFFTHENGOSUB400
195 IF(Y>222ANDV2<-10)ORCSTHENGOSUB300
200 POKE55296,7:POKE55326,7:POKE2040,15:GOTO100
297 REM ********************************
298 REM * MISSION REPORT ROUTINE       *
299 REM ********************************
300 POKENH,2:POKENL,179:POKE54296,15:POKEAD,88:POKESR,2
    40:POKEWA,129:CK=1
304 POKE2040,11:POKEV+28,1
305 GOSUB380:POKEV+29,31:GOSUB380:POKEV+23,1:GOSUB380:G
    OSUB390
310 POKEAD,00:POKESR,00:POKEWA,00
315 GOSUB392:PRINTH$P$:PRINTTAB(32)"CRASHED"
317 POKEV+29,30:POKEV+23,0:POKEV+21,30:POKEV+28,0:GOTO3
    70
350 GOSUB392:PRINTH$P$:PRINTTAB(32)"ABORTED":GOTO370
360 GOSUB392:FC=FC-3:IFFC>4THENFC=4
362 PRINTH$P$:PRINTTAB(32)"          "
363 PRINTH$P$:PRINTTAB(32)MR$(FC);TAB(73)"FLIGHT":FORJ=
    1TO4000:NEXTJ
370 J=PEEK(56320):IFJAND16THEN370
371 IFNOTJAND2THENPOKEV+21,0:CLR:PRINTCHR$(147):END
375 GOSUB395:GOSUB900:GOSUB584:FF=PEEK(V+30):FF=0:TI$="
    000000":RETURN
380 FORJ=1TO25:Z=INT(60*RND(1))+1:POKE705+Z,J:NEXT:RETU
    RN
390 FORJ=704TO766:POKEJ,00:NEXT:RETURN
392 PRINTH$:PRINTTAB(32)R$"MISSION"TAB(72)R$"REPORT:":R
    ETURN
395 PRINTH$P$:PRINTTAB(32)"[SPACE][SPACE][SPACE][SPACE]
    [SPACE][SPACE][SPACE]"TAB(72)"[SPACE][SPACE][SPACE
    ][SPACE][SPACE][SPACE][SPACE]":RETURN
396 REM********************************
```

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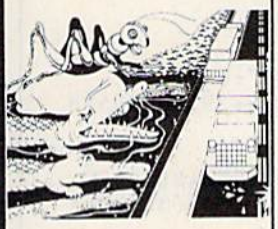

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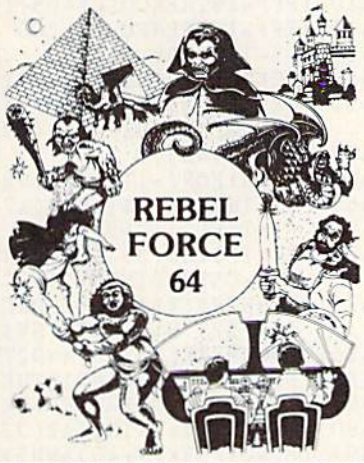

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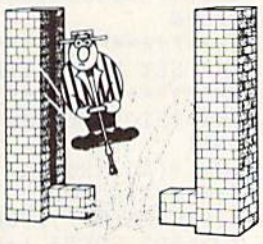

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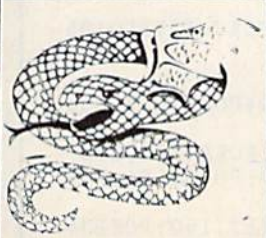

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Listing 1 continued.

```
397 REM* LANDER SPRITE/PAD SPRITE      *
398 REM* COLLISION HANDLER ROUTINE      *
399 REM*********************************
400 IFV2<-100RABS(X1)>1.5 THENGOTO300
403 IFFF=16ANDX<210THENGOTO300
405 PRINTH$P$:PRINTTAB(32)"LANDED ":POKE2040,15:POKEAD,
    0:POKEWA,0
410 IFFF=16THENGOSUB495:IFQ=1THEN360
415 IFFF=16THENFU=FU+200
435 Y=Y-1:POKEV+1,Y
440 IFCKTHENPRINTH$P$:PRINTTAB(32)"STANDBY":CK=0
450 FORJ=1TO4:IFFF=2[UP ARROW]JTHENIFPEEK(V+39+J)AND5TH
    ENFU=FU+300:POKEV+39+J,2:FC=FC+1
455 POKE(V+43),5
460 NEXTJ:FORI=1TO1500:NEXT:PRINTH$P$P$:PRINTTAB(34)FC
465 PRINTH$P$P$P$;CHR$(17)TAB(32)TI$P$:PRINTTAB(33)STR$
    (INT(FU))+"[SPACE]"
470 PRINTP$TAB(33)STR$(INT(A2))+"[SPACE]":PRINTP$TAB(32
    )"V:"STR$(INT(V2))+"[SPACE]"
471 HV$=STR$(X1*3)+"[SPACE][SPACE][SPACE][SPACE]":PRINT
    TAB(32)"H:"LEFT$(HV$,5)
475 IFNOTPEEK(56320)AND2THEN350
480 IFPEEK(56320)AND16THEN465
485 V1=5 :C1=2:X1=0:FF=PEEK(V+30):FF=0:A2=A2+4
490 PRINTH$P$:PRINTTAB(32)"ACTIVE!":RETURN
495 IF(NOTPEEK(V+40)AND5)AND(NOTPEEK(V+41)AND5)AND(NOTP
    EEK(V+42)AND5)THENQ=1
496 RETURN
497 REM*********************************
498 REM* SET UP SPRITE DATA AND SCREEN *
499 REM*********************************
500 FORI=13TO15:FORJ=0TO62:READA:POKE(I*64)+J,A:NEXTJ:N
    EXTI
504 DIMMR$(4):MR$(1)="GREAT":MR$(2)="GOOD":MR$(3)="FAIR
    ":MR$(4)="POOR"
506 PRINTCHR$(147):POKE53281,11:POKE53280,12:FORJ=55296
    TO56295:POKEJ,1:NEXTJ
508 FORJ=1055TO2023STEP40:POKEJ,160:POKEJ+0F,4 :POKEJ+8
    ,160:POKEJ+8+0F,4 :NEXTJ
510 FORJ=1055TO1062:POKEJ,160:POKEJ+0F,4 :POKEJ+960,160
    :POKEJ+960+0F,4 :NEXTJ
512 FORJ=1249TO1252:POKEJ,160:NEXT:FORJ=1289TO1292:POKE
    J,160:NEXT:POKE1288,95
515 FORJ=1064TO1984STEP40:POKEJ,160:POKEJ+30,160:NEXT
516 POKE1105,223:POKE1145,105:POKE1225,223:FORJ=1265TO1
    425STEP40:POKEJ,160:NEXT
517 POKE1024,81:POKE1024+0F,2:POKE1054,81:POKE1054+0F,2

518 POKE1105,223:POKE1145,105:POKE1225,223:FORJ=1265TO1
    425STEP40:POKEJ,160:NEXT
520 POKE1465,105:POKE1745,223:POKE1785,160:POKE1825,105
    :POKE1905,223
522 POKE1945,160:POKE1946,223
524 FORJ=1984TO2013:POKEJ,160:NEXT
526 POKE1093,233:FORJ=1133TO1293STEP40:POKEJ,160:NEXT:P
    OKE1333,95:POKE1413,233
530 FORJ=1453TO1893STEP40:POKEJ,160:NEXT:POKE1933,95:PO
    KE1973,233
532 POKE1172,233
535 POKE1352,223:POKE1353,233:POKE1391,233:POKE1394,105

536 FORJ=1392TO1552STEP40:POKEJ,160:NEXT:FORJ=1393TO195
    3STEP40:POKEJ,160:NEXT
538 POKE1431,95:POKE1592,95:POKE1672,95
539 POKE1752,233:POKE1792,160:POKE1832,160:POKE1872,95:
    POKE1791,233:POKE1831,95
542 POKE1471,233:POKE1511,160:POKE1551,95:POKE1510,233
545 POKE1434,223:POKE1474,160:POKE1514,105:POKE1554,223
    :POKE1594,160
547 POKE1595,223:FORJ=1634TO1954STEP40:POKEJ,160:POKEJ+
    1,160:NEXT
549 POKE1716,233:POKE1717,223:POKE1757,105:POKE1797,223
    :POKE1837,105
```

Continued on page 52.

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Listing 1 continued.

```
550 POKE1876,105:POKE1916,223:POKE1956,105:FORJ=1756TO1
    836STEP40:POKEJ,160:NEXT
554 POKE1442,223:POKE1443,223:POKE1444,233:POKE1445,223
    :POKE1485,105
556 POKE1481,95:FORX=1482TO1602STEP40:POKEX,160:NEXT
558 FORJ=1483TO1963STEP40:POKEJ,160:POKEJ+1,160:NEXT
560 FORJ=1525TO1965STEP40:POKEJ,160:NEXT:FORJ=1526TO160
    6STEP40:POKEJ,160:NEXT
565 FORJ=1766TO1966STEP40:POKEJ,160:NEXT:POKE1646,105:P
    OKE1726,223
567 POKE1486,233:POKE1567,105:POKE1807,223
570 POKE1967,233:POKE1968,233:POKE1451,95:POKE1452,160:
    POKE1651,233:POKE1691,95
573 POKE1492,233:FORJ=1492TO1812STEP40:POKEJ,160:NEXT:P
    OKE1852,95
575 POKE1521,233:POKE1561,95:POKE1642,95:POKE1723,95:PO
    KE1763,32:POKE1803,233
577 POKE1842,233:POKE1882,95:POKE1922,233
584 P$=CHR$(17)+CHR$(17)+CHR$(17):H$=CHR$(19):R$=CHR$(1
    8)
585 PRINTH$;CHR$(5  ):PRINTTAB(32)R$"MISSION"TAB(72)R$"
    STATUS:"
587 PRINTH$P$P$;CHR$(17):PRINTTAB(32)R$" TIME: ":PRINTP
    $TAB(32)R$" FUEL: "P$
591 PRINTTAB(32)R$" ALT:  "P$:PRINTTAB(32)R$" VEL:  "
596 PRINTH$P$P$TAB(32)R$"REFUELS"
597 RETURN

896 REM*********************************
897 REM* DEFINE AND ENABLE SPRITES     *
898 REM* 1 THRU 5 AND GAME VARIABLES   *
899 REM*********************************
900 V=53248:X=219:Y=70:D=3:CR=0:POKEV+31,0:FU=0:A2=456:
    V1=0:X1=0
910 POKEV+21,31:POKE2040,15:POKEV,X:POKEV+1,Y:POKEV+27,
    1:CK=1:Q=0:V2=0
916 POKE2041,13:POKE2042,13:POKE2043,13:POKE2044,13
918 POKEV+2,48:POKEV+3,242:POKEV+4,124:POKEV+5,242:POKE
    V+6,215:POKEV+7,242
919 POKEV+8,210:POKEV+9,90
920 POKEV+39,15:POKEV+40,5:POKEV+41,5:POKEV+42,5:POKEV+
    43,2
922 POKEV+29,30:POKEV+37,7:POKEV+38,2
930 FORJ=54272TO54296:POKEJ,0:NEXT:WA=54276:AD=54277:SR
    =54278:NL=54272:NH=54273
940 POKENL,216:POKENH,12:FC=0
950 RETURN
996 REM*********************************
997 REM* DATA FOR SPRITE DATA BLOCK    *
998 REM* 13, 14, AND 15                *
999 REM*********************************
1000 DATA255,255,255,255,255,255,255,255,255,255,255,25
     5,255,255,255,255,255
1002 DATA255,255,255,255,255,255,255,255
1003 DATA0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
     0,0,0,0,0,0,0,0,0,0,0,0,0

1004 DATA0,0,0,0,0,0,32,254,24,35,255,160,31,255,216,15
     ,255,192,31,255,192
1006 DATA63,255,248,127,255,252,127,255,252,127,255,248
     ,63,255,240,15,255,240
1008 DATA19,255,152,38,56,68,120,124,62,64,254,2,64,210
     ,2,64,169,2
1010 DATA65,85,2,194,51,131,0,0,0
1012 DATA0,0,0,32,254,24,35,255,160,31,255,216,15,255,1
     92,31,255,192
1014 DATA63,255,248,127,255,252,127,255,252,127,255,248
     ,63,255,240,15,255,240
1016 DATA19,255,152,38,56,68,120,124,62,64,254,2,64,0,2
     ,64,0,2
1018 DATA64,0,2,192,0,3,0,0,0
```

More

three lower pads have been visited. A subroutine at line 495 is called. If all lower landing pads are red, then variable Q is set to 1. The subroutine returns to line 410, and if Q is equal to 1, the program goes to the mission-complete routine at line 360. If the mission is not complete, 200 extra units of fuel are added to the shuttle in line 415.

The Y coordinate is updated after a landing by line 435. Line 440 prints a status report update if the program has returned from the crash routine. If the shuttle has landed on one of the three lower pads, lines 450–455 refuel the shuttle and change the color of the landing pad the shuttle is on from green to red, and update the refueling counter. The upper pad is then colored green in case it has changed to red from a refueling.

The mission-status instrument readouts are updated in lines 460–471; the program then waits for the fire button to be pushed for take-off. If the joystick handle is pulled down and the fire button pressed, the mission is aborted. When take-off is initiated, line 485 sets vertical and horizontal velocity, clears the sprite-to-sprite collision register and resets the shuttle altitude. The mission status is updated in line 490 and the shuttle is once again in flight.

Lines 100–200: The main program loop controls the game while the shuttle is in flight. Line 100 sets collision flags CS and CP to 0, resets the sprite-to-background collision pointer and reads the value of joystick port 2. If the fire button is not pushed, line 105 sets the vertical acceleration variable and turns off the sound of the rocket engine.

When the fire button is pressed, lines 107–113 handle the rocket routines. Line 107 sets the sound volume to high and turns on the sound of the rocket. The fuel total is lessened, deacceleration is set and sprite 0 is defined as the graphics image in memory section 14 (shuttle with exhaust).

The program then checks to see if the joystick is pushed left, right or up. When it's left or right, horizontal velocity is incremented or decremented in lines 110 and 112. When the joystick is pushed forward, line 113 increments the fuel variable and sets the acceleration variable to hold velocity at a constant value.

Line 150 changes the color of the warning beacons at the top of each side of the canyon to red, and then calculates velocity and altitude. Line 155 checks the sprite/background collision register at location V+31 to determine if the shuttle is in contact with the canyon walls. Collision counter CR is reset

to 0 if the shuttle is clear of the walls. The X and Y coordinates of the shuttle are calculated in line 176. If the shuttle is too high in altitude and being affected by the magwinds, horizontal velocity is increased.

Line 177 is the in-flight crash check. If the shuttle has been hurled into the far right- or left-hand wall, or is high enough into the magwinds to be destroyed, the program calls the crash routine at line 300.

Line 178 clears the sprite/background collision register and pokes the shuttle coordinates into the X and Y position registers of sprite 0. The sprite/background collision register is rechecked, and, if a collision has occurred, the collision counter is incremented by 1. If the collision counter is greater than 1, the collision flag CS is set to 1.

The mission computer readouts are updated in lines 180–186. Line 190 checks for a sprite/sprite collision, and calls the shuttle/pad collision routine at line 400 if required. Line 195 calls the crash routine at line 300 if the crash flag is set; otherwise, the beacon colors are turned to yellow and sprite 0 is defined as memory section 15.

The program then jumps to line 100 and continues the loop.

Game-Playing Hints

After the game program is entered into your machine, you're ready to fly a mission.

Until you get the feel of the shuttle, be careful when taking off. Positive vertical velocity builds up rapidly and you'll find yourself in the magwinds. Push the joystick to the left as you take off to build up horizontal velocity to help you clear the landing pad. The shuttle's on-board computer will hold the horizontal velocity constant until increased or decreased by the joystick.

The lower pads are green until you land; then they turn red. If you reland on a red pad, you won't receive any fuel, since it already has been depleted.

If at first you are burning too much fuel, take off and then immediately reland on the upper pad. Each time you reland, your fuel reserves will build. Your final score will suffer, but you'll be able to complete the mission.

If you find yourself on a lower pad and feel you don't have enough fuel to continue, pull back on the joystick and the mission will be aborted.

Conclusions

Enjoyable games can be written in Basic without using assembly-language routines. The sprite graphics capabilities built into the Commodore 64 let the programmer control hi-res graphics images easily. Canyons of Zelaz can be further modified and enlarged by adding your own routines to it.

The purpose of Canyons of Zelaz was to provide an example of how to use sprite graphics in game scenarios. I hope this prompts you to enjoy the game, modify and change it and then write your own game and send it to *RUN*.

For those of you who dislike typing listings, send me a self-addressed stamped mailer, a blank tape and $3—or $5 without mailer and tape—and I'll send you a copy of the program. R

For more on the Commodore 64's sprite graphics capabilities, see *Microcomputing*, June 1983, p. 60—"Sprites, Graphic Eyes and the C-64."

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The Commodore Connection— How to Hook Up Your Printer

After buying my Commodore 64 with Datassette recorder, the first peripheral I needed was a printer. So I chose the Okidata Microline 82A.

By Charles T. Kowal

I wanted something a little more elaborate than Commodore's 1525, and the Microline offered both serial and parallel ports, and promised to be easy to interface with the computer. It was not as easy as I thought!

There are basically three ways to connect the computer to a printer. You can plug the VIC RS-232C module into the user port and connect it to the serial port of the printer; you can use the parallel output of the user port connected to the parallel input of the printer through a suitable interface; or you can connect the six-pin serial port of the computer to the parallel port of the printer, again through a suitable hardware adapter. Each of these methods has advantages and disadvantages.

RS-232 Serial Method

The first thing I tried was the RS-232C serial interface. One of the advantages of a serial interface is that it is relatively immune to electrical interference, and you can place the printer many feet away from the computer without worrying about getting garbled printouts. Concomitantly, you can transmit to the printer at various baud rates, and have full handshaking.

The VIC RS-232 interface module plugs into the user port. This means that you cannot use a modem and the printer at the same time, since they both use the same port. If you are using the Datassette recorder, you must be careful not to use the recorder and the printer at the same time.

For example, you cannot read some data from a tape, print it out, and then immediately read more data, because some of that data will be lost while the printer is doing a carriage return. You must be certain that the printer has completely finished its job before again using the cassette recorder. This problem does not arise, however, when you use a floppy disk drive instead of a cassette recorder.

Connecting the printer to the RS-232 interface is a little tricky. (Unfortunately, there is nothing standard about the RS-232 "standard"!) You will need to make your own cable, or use a regular RS-232 cable with your own connector. The proper connections between the RS-232 module and the Okidata serial port are shown in Table 1.

The RS-232 port is addressed by the computer as device number 2. To open an RS-232 output file to the printer, you

RS-232 module	Pin		Printer serial port Pin	
ground	1		1	protective ground
trans. data	2		3	receive data
RTS	4	Connect pins 4 and 5	No connection to printer	
CTS	5	together	No connection to printer	
DSR	6		11	SSD (busy)
ground	7		7	signal ground
DTR	20		6	DSR

Table 1. Connections between the RS-232 module and the Okidata serial port.

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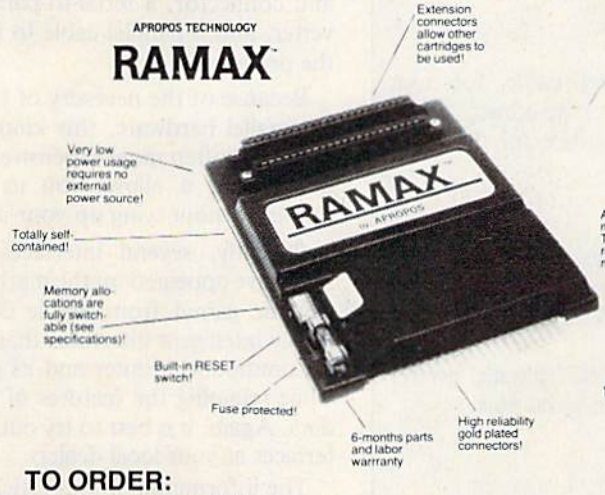
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should use a line similar to this:

```
OPEN 2,2,0,CHR$(8)+CHR$(1)
```

The first number after OPEN is the logical file number. You can use any number from 1 to 127. The second number is the device number. This is always 2 for the RS-232 port. The third number is the secondary address. This number seems to be completely arbitrary, but zero is recommended.

CHR$(8) sets the baud rate to 1200 bits per second, which is the most that the Okidata printer can handle (unless you have the high-speed serial interface).

CHR$(1) specifies that handshaking is being used. That means that the computer will wait until the printer is ready before sending more data.

In the following discussion we will assume that you are using logical file number 2.

To send data to the printer, open the file, as above, and use the command:

```
PRINT#2, (variable or string)
```

To list a program, open the file and write:

```
CMD2: LIST
```

At the end of the program or listing, you must check to see that all of your data has actually been printed. Do this with PRINT#2 commands. This is necessary because the computer sets aside 512 bytes of memory as a buffer, whereas the printer's own buffer holds only one line of output.

At the end of the program, when no more data is going into the computer's buffer, it will stop sending data to the printer. When you give the PRINT# command, the printer will only accept one line of data, no matter how much data is still in the computer's buffer. So give this command repeatedly, until you are sure everything has been printed.

If you have a program that prints out a lot of data, it is a good idea to end the program with a line such as:

```
10000 PRINT#2: GOTO10000
```

After all data has been printed, type CLOSE2 to close the file.

Most of the minor problems of RS-232 interfacing can be overcome by using Okidata's High-Speed Serial Interface with a 2K buffer. If you have the Okigraph graphics package, you cannot use the low-speed interface, anyway.

Parallel to Parallel Method

Another way of connecting a printer to your Commodore is to use the parallel output of the user port and the parallel input of the printer. This requires a parallel cable and some software to handle the data transmission and handshaking. Unless you are adept at writing machine language programs, it is probably best to just buy one of the parallel interfaces available through dealers or by mail order.

Choose the method that will best meet your computing needs.

I have been using a package called Smart ASCII from Midwest Micro Associates (PO Box 6148, Kansas City, MO 64110). Selling for about $60, this interface includes a cable and a machine language driver. A very handy feature of this program is that it translates unprintable characters into spelled-out words or abbreviations.

For example, if your program includes a clear-screen command, the "clear" character appears as a reversed heart on your TV screen, and an odd graphics character on the printer. Using the Smart ASCII program, this character will be translated into the letters (CLR) on the printout.

Similarly, the cursor control characters get printed out as (UP), (DN), (LF) and (RT). I have even modified the program to print the character PI, to enclose the translated words in brackets instead of parentheses, and to allow for 132-character lines. There are now several printer interfaces that include such a translation feature. You had best try out several of them at your dealers, in order to select the one which has the best features for your needs.

When using any parallel interface, the printer must be located near the computer. Cable lengths of about three feet are typical. Even then, it is best to keep the printer cable far from any source of stray electrical signals, such as a motor or transformer.

Midwest Micro, Inc.
311 W. 72nd St.
Kansas City, MO 64114.

Product: "Smart ASCII" interface, with cable for user port.

Micro Ware Distributing, Inc.
1342B Rte. 23
Butler, NJ 07405.

Products: Parallel cable for user port, with driver routines; "The Connection" interface for the 6-pin serial port.

Micro World Electronix
3333 S. Wadsworth Blvd., #C105
Lakewood, CO 80227.

Product: "MW-302" parallel printer interface for 6-pin serial port.

Cardco, Inc.
313 Mathewson
Wichita, KS 67214.

Product: "Card/Print" interface for 6-pin serial port.

Table 2. Suppliers of parallel printer interfaces for the Commodore 64.

Serial to Parallel Method

The final method of hooking up a printer has the great advantage of leaving the user port free. This allows you to use a modem at the same time as the printer. Commodore's own printers connect to the six-pin serial port, and there are adapters available to allow you to do the same with other parallel printers. These devices include a serial cable and connector, a serial-to-parallel converter, and a parallel cable to plug into the printer.

Because of the necessity of the serial-to-parallel hardware, this kind of connection is often more expensive than the others, but it allows you to use the printer without tying up your user port.

Recently, several interfaces of this type have appeared on the market. They run the gamut from simple devices to highly intelligent interfaces that emulate a Commodore printer and its graphics, while retaining the features of the Okidata. Again, it is best to try out these interfaces at your local dealers.

The information in this article applies to both the C-64 and the VIC-20. The parallel interfacing will work with any Centronics-compatible printer, including Epson and NEC. The RS-232 connections, however, will be different for printers other than Okidata. See your printer manual for details. (Okidata Corp., 111 Gaither Drive, Mt. Laurel, NJ 08054; 609-235-2600.) R

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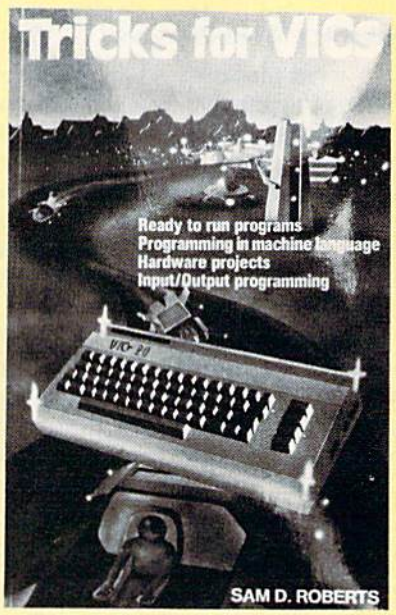

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C-64 Word Processing Demystified!

You can become a word wizard and perform enchanting feats of magic with the wealth of word processors available for the Commodore 64. This article takes a look at what's available and presages the time when you will be manipulating your text with consummate skill. Although word processing may appear to be magical, there's no trickery involved. Anyone can do it.

What Is a Word Processor?

A word processor is basically a computer program that you direct to perform very specific operations under two general categories. The first deals with editing—actually changing the content of what you have written. The second has to do with formatting your text, determining its appearance when printed or displayed on the screen.

The editing function is a simple electronic tool for manipulating text before it is ever printed. With it, you can easily correct simple mistakes, such as typing the wrong letter or transposing letters.

Using the edit mode, you can automatically print hundreds of letters with the same body of text, but with a different greeting for each person. Or, if you're composing a term paper, you can delete, insert and change to your heart's content, with no erasures or messy scribblings.

Not only can you change the text itself, but you can modify the way it appears when printed. Using the word processor's formatting capacity, you can set your margins narrow or wide, double-space the material, specify paragraph indentation, center your titles and generally tidy up your manuscript.

A word processor is a wonderful tool that anyone who types can easily learn to use. Before I discuss some of the programs that are currently available for the Commodore 64, I'll define some important terms you should be familiar with when selecting or using a word processor.

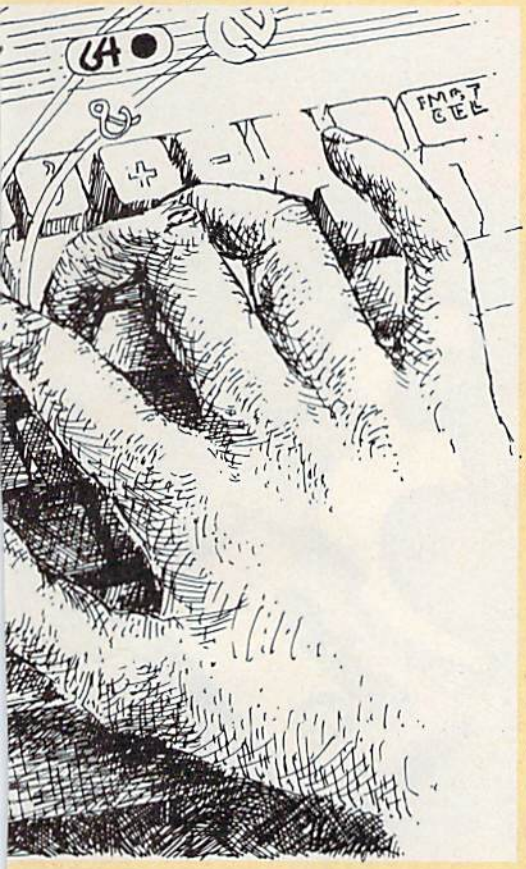
Some Important Terms

Word Wrap: Most word processors allow you to keep typing beyond the right-handed border of your video screen. You don't have to worry about hitting the return key, since the text automatically "wraps around," that is, continues at the left-hand margin of the next line. Some word processors even move complete words, rather than allowing partial words on a line.

Save or Write to a file: After you have typed in a certain amount of text, you will probably want to "save" this for later use as a "file" on tape or disk. The "save" or "write" command allows you to assign the text to a file, which actually becomes a physical entry on the disk or tape. Some word proces-

The introduction to this article, the definition of terms and the reviews of Busiwriter 64, HESWRITER 64, Wordcraft 64, TOTL.TEXT 2.6 and WordPro 3 Plus/64 are by Neil J. Salkind, 1235 Tennessee St., Lawrence, KS 66044. The reviews of Easy Script 64, Paper Clip, Writer's Assistant and Script-64 are by Robert W. Baker, 15 Windsor Drive, Atco, NJ 08004. Wordmanager was reviewed by Don Raab, North Country Community College, Saranac Lake, NY 12983. The review of Quick Brown Fox is by Guy Wright, RUN *technical editor.*

By N. Salkind, R. Baker, D. Raab, G. Wright



sors allow you to examine the list of all the files on a disk or tape by displaying the "directory."

Search: You can use the word processor to "search" through a file and stop at each place a specified string of characters appears.

Read: The "read" command allows you to access text which you have previously saved. You can stop work in the middle of a document, write the text to tape or disk, turn off your computer and then come back later, read the file that was saved and continue your work. In a matter of seconds, you have the complete file ready to be added to or modified.

Paginate: You can direct your word processor to automatically place page numbers in a sequence at selected positions on each page. Some word processors even allow you to number pages beginning with any number you want, a great help for people writing long documents that need separate sections numbered differently.

Center: This formatting command centers a line or group of words between the left and right margins of the screen or paper. This is especially handy for titles.

Justification: Look at the way this article is printed, and you will see that the words along the right-hand margin are all perfectly aligned. This is called justification. Depending upon the user's needs, it can be a nice addition to any word processing package. Letters often are not justified, while manuscripts are, but this depends upon the needs and preference of the user.

Pitch: This feature allows you to adjust the number of characters that are printed per inch. On a standard typewritten page, there are usually ten or 12 characters per inch, but many word processors have the capability of printing as few as 4 or as many as 15 per inch. This is an excellent way to highlight phrases or words that are of importance in your document.

File Merge: Every word processor has a limit as to how many characters (or words or sentences) it can work on at once. Because many documents are longer than this limit allows, you sometimes need to link separately created files with one another when you print the entire document.

This may sound bothersome, but it has many practical advantages. For example, if you have one file at a time in your workspace, there's no possibility of losing more than that amount of text if you accidentally erase the file.

Boiler Plate: You may often want to write several letters or other documents that have only minor changes, such as a name or address, or the specific terms of an agreement. The part of the document that does not change is called a "boiler plate."

Move: Word processors can move a line or section of text to another part of the document. For example, if you want to rearrange the order of a glossary or of tables, you can do so using this command.

Insert: You might want to move some text around or rearrange your ideas. You may also want to insert some new ideas in a section already written. With this option, the insertion is simple.

Tabs: If you use columns in your documents, the tab feature allows you to automatically line up columns of numbers, decimal points or other characters. This is especially convenient when you are doing tables or accounting work.

Now the Reviews

The five word processors I am about to review were tested on a system consisting of a Commodore 64 computer, a 1541 disk drive and an Okidata 92 printer. The interface I used was the MX-302, manufactured by Micro World Electronix, Inc., 6340 West Mississippi Ave., Lakewood, CO 80226.

All of the five programs worked without any problems. The only adjustments necessary had to do with the switches on the interface used to control printer functions.

Busiwriter 64

Busiwriter 64 (Skyles Electric Works, 231E South Whisman Road, Mountain View, CA 94041; $69) is a disk-based machine language program that is compatible with a wide range of printers.

Format, printer control and editing commands are all embedded in the text and are represented using special screen symbols for each particular operation.

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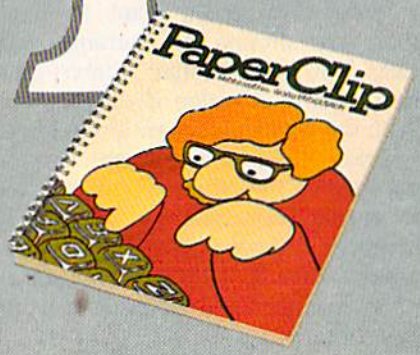

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In addition, you use all of the function keys to perform such operations as page forward, next screen and delete text.

The Commodore key is also used extensively in the editing mode. You reach all modes through an initial menu that appears after the program is loaded. The screen also shows you the format of output as it will appear when printed.

Printer characteristics and other necessary information, such as the number of lines per page and automatic return, are defined using a preset screen, where you type over the values already preset as if the printer were a VIC.

What I Liked...

There are more good things about Busiwriter than I have room to describe. This is a full-fledged, well-documented and logically organized word processing program that is easy to learn and use.

To begin with, it has a large work space (almost 35,000 characters worth) that gives you 15 to 20 pages of room before you have to worry about linking files.

Another nice function of this friendly program is the side scrolling that allows you to move the screen with the text. When the margin width is adjusted, you immediately see the change in format on the screen. In addition, when you are entering text, spaces in the lines are represented by dots, a great help when you want to align columns without using the tab feature.

Busiwriter also contains on the program disk the best set of tutorials available to date. You pick an example of what you want to do, and then see it on the screen or on the printer. Best of all, you can merge a listing of commands and format symbols at the top of the work page for each access.

Other positive features are the comprehensive manual (including a clearly written quick reference section at the beginning), easy changing of colors and saving to disk, and friendly user support from the company. A backup disk is available for $10.

What I Didn't Like...

My only complaints with this package are that it lacks an index and has no paginate feature.

Summary...

The price may be a bit steep, but I don't think there is a word processor available for the C-64 that is more comprehensive or easier to use. Busiwriter is a tool for the beginner as well as for the more advanced writer.

HESWRITER 64

HESWRITER 64 (Human Engineered Software, 71 Park Lane, Brisbane, CA 94005; $39.95) is a cartridge-based word processor that is ideal for writing brief documents or letters. You plug the cartridge into the back of your Commodore 64 *before* you turn on the computer. Format commands are embedded directly into the text, preceded by an up arrow, and you initiate both format and editing commands with one keystroke.

What I Liked...

Probably the outstanding features of HESWRITER are its easy-to-use format and commands. The program is designed so that you execute each mode, such as Find, by typing the first letter of the command and hitting return. The screen border immediately turns a unique color (orange in the case of Find), telling you that a change has occurred.

Another nice feature is the line-numbering option, where, in edit mode, you can conveniently direct the program to the point in the text where attention is needed. HESWRITER also allows you to preview the formatted output on the screen, before it is actually sent to the printer.

What I Didn't Like...

Probably the most serious shortcoming of HESWRITER 64 is the two- to three-second delay between lines when printing. This happens because the program is written in Basic, and the software is not able to provide information to the printer as fast as the printer can function.

Summary...

For a first-time word processor, the ease of the cartridge and the one-letter command are attractive features of this software. For the user who needs to write and edit long documents, HESWRITER 64 may not be powerful enough.

Wordcraft 64

Wordcraft 64 (United Microware Industries, Inc., 3503 Temple Ave., Pomona, CA 91768; $149.95) is almost identical to the earlier—and successful—Wordcraft 20 developed for the VIC-20. I say almost identical, since the documentation was not yet available for

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Wordcraft 64, so UMI sent me the Wordcraft 20 instruction manual and assured me that all the commands were the same. Except for one minor change, they were.

Wordcraft 64 was so new that the company had not yet completed the plastic shell for this cartridge-based word processor! I ended up plugging a naked circuit board and two integrated circuits into my 64!

As soon as the machine is turned on, Wordcraft 64 displays a colorful menu of options from which you choose according to the kind of printer you are using. Using the function keys, you specify parallel or serial, the baud rate and whether sheets will be fed continuously or by hand. You need to know the characteristics of your printer intimately to get this correct the first time around, and a little experimentation might be necessary to find the correct combination.

After you make your choices from this menu and press the space bar, Wordcraft is ready to go. On the first of three direction lines, you find a copyright notice. This line is also used for diagnostics. The second line indicates information about the length of the document, the cursor position, including column, line and page number, plus the number of characters that have already been entered. The third line indicates the mode, either Type (for text entry) or Command (for format).

A sophisticated word processor doesn't have to be difficult. With clear documentation, your time spent to master it will be well worth the effort.

When in the type mode, you enter text. You can also initiate control commands (by hitting the CBM key and then some character) for editing functions, such as moving blocks, searching for a string and setting tabs. The command mode consists of formatting commands, such as justification, sending ASCII values to the printer and page width.

This also becomes a problem when you are typing faster than the program can accept the input. What happens is that the cursor doesn't move until the program can catch up.

Another inconvenience is that you can only insert one line at a time, and then only after you know the number of the line you want the new line to precede. To determine the number, use the line number function, although this can become increasingly confusing if you have more than one line to insert.

The same kind of inconvenience characterizes the program when you wish to begin a new file. The manual directs you to use the Delete function, rather than some kind of erase function, to erase all the lines in the present file.

Finally, if you have made an error in a previous line, you cannot move the cursor to that point, but instead must enter the edit mode to make the correction. Leading spaces (such as in paragraphs) are also not allowed. Instead, you need to use a secondary margin setting in conjunction with a new line command simply to indent a given number of spaces.

What I Liked...

This is a simple-to-use, yet powerful word processor. Besides having com-

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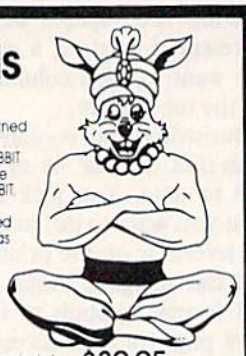

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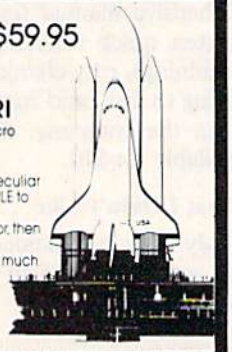

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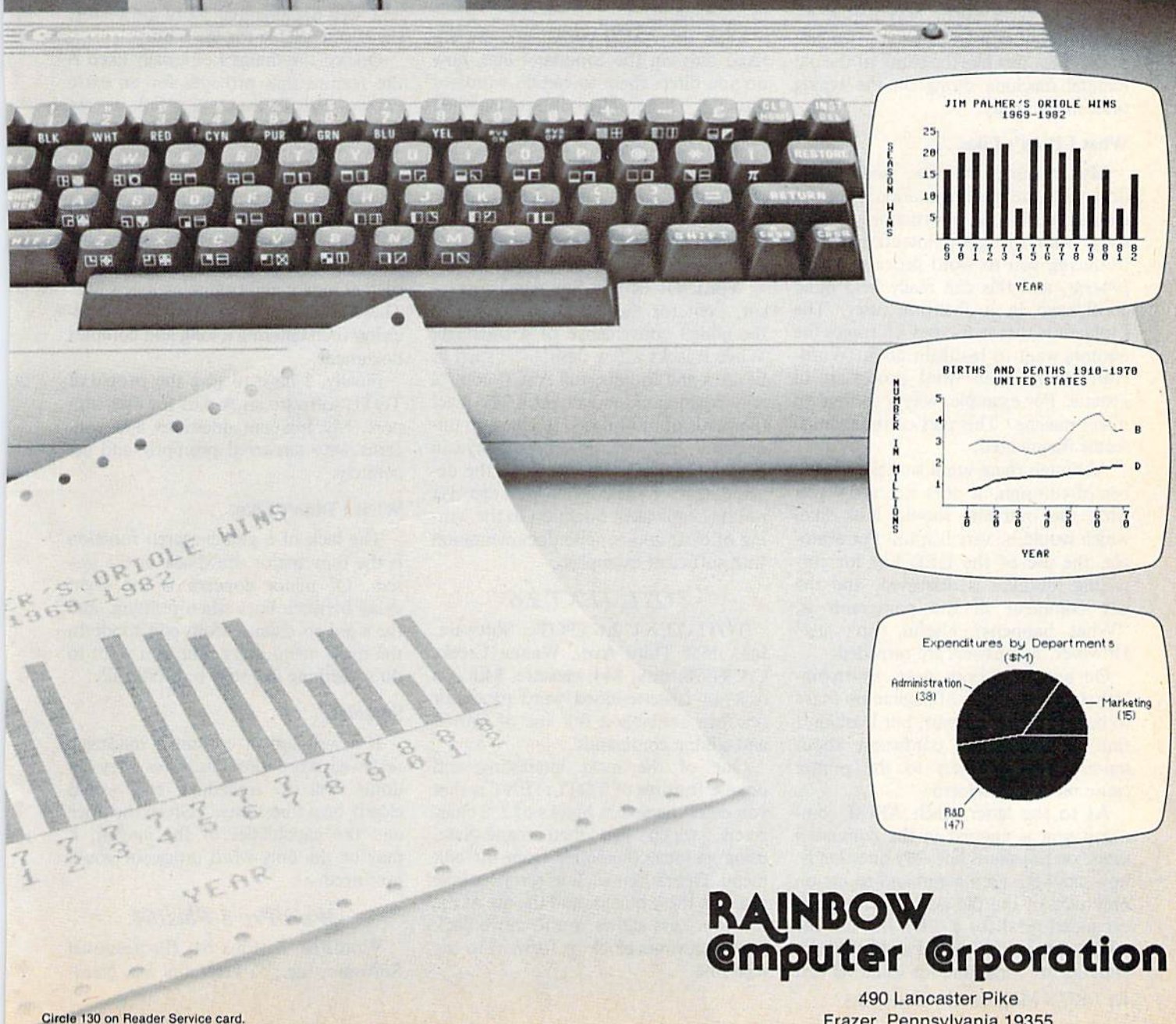

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plete scrolling capability in all four directions (up, down, left and right), it formats the text on the screen. For example, when you press the CBM key and the equals sign, the current line is instantly centered. This instant formatting feature is especially nice for people who do such things as newsletters, and need to know how long a certain column must be to yield so and so many pages. All of this can be ascertained by referring to the page counter in line 2 on the screen.

Another helpful feature of Wordcraft is the flashing screen and the diagnostics. For example, when you try to load a file that you have not yet written to a disk or tape, the screen flashes and reminds you to save it first.

I also like the use of all eight function keys for such necessary and frequent tasks as deleting lines (F2) or words (F1), or beginning new pages (F8) or lines (F7). You might also appreciate the option of audio feedback when you press a key, just like the clunk of the old manual machine sitting on the typing table in the study.

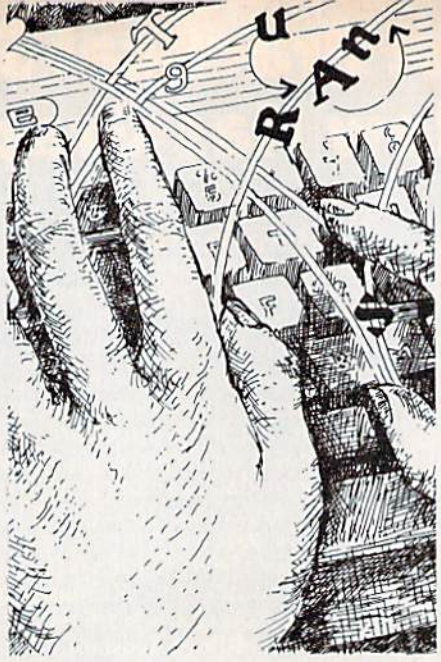
What I Didn't Like...

My criticisms are few, and mostly deal with the documentation. The introduction in the instruction manual starts with the good intention of introducing you to word processing *as a process*, and this can really help build confidence in a first-time user. The problem is that it focuses on topics the authors want to highlight about Wordcraft, rather than word processing in general. For example, why a section on direct mailing? This part of the manual seems fragmented.

Although there are a sufficient number of tutorials, it does not show you what the outcome should look like, which would be very helpful. For example, the use of the DEL key for correcting mistakes is discussed, and the last comment in the paragraph is, "What happens? Useful, isn't it?" However, no answers are provided.

On a more serious note, shortcomings such as the lack of pagination (hard to believe it doesn't exist, but I couldn't find it) and some confusion about sending ASCII codes to the printer cause me some concern.

As to the latter, each ASCII command sent is entered in the command mode on the status line. My question is, how can you get a command to act on only *part* of the file (say, for example, expanded print for a title), but not the text? I assume this should be possible by entering the command for whatever text



you want acted on and then disabling the command.

Since the ASCII commands are entered only on the command line, how do you direct them to certain words or phrases? The problem also arises when you want to review the file. Since these commands are embedded as part of the text (as is the case with the majority of word processors), it is difficult to diagnose and correct.

Summary...

Wordcraft 64 is a fine word processor, even for the advanced user, with the added convenience of a cartridge. While it lacks a few desirables, such as headers and footers, full ASCII control and pagination, it will probably meet the needs of most users. It's hard to understand, however, how a company can devote resources and energy to the development of such a fine package, yet not pay equivalent attention to the writing of clear and concise documentation with sufficient examples.

TOTL.TEXT 2.6

TOTL.TEXT 2.6 (TOTL Software, Inc., 1555 Third Ave., Walnut Creek, CA 94596; disk, $44; cassette, $40) is a disk- or cassette-based word processor that has available a full line of format and editing commands.

One of the most interesting and unique features of TOTL.TEXT is that you enter the text in blocks of 255 characters, which you then manipulate, using various commands from the edit menu. Operations such as scrolling take place on these blocks, and the use of the function keys allows you to move back to the previous block or forward to the next one.

Returning to the main menu lets you elect to go to any block. Like other word processors, format commands are placed in the context of the document using "$$" before each one.

Another feature of TOTL.TEXT is the use of what the authors call "Chickspeed," a machine language component of the system that allows increased speed in loading and printing of documents.

The documentation emphasizes how you can directly change program commands in the line listing itself to custom fit your system. This also explains why the disk is not protected. In fact, unlike other disks, there is no write/protect notch, and the authors encourage you to make a backup copy of the program for safekeeping.

What I Liked...

This is a very complete, easy-to-learn and well-documented word processor, the best available for the money.

One of the things I especially liked is the feature that provides for an extra copy of the file that you saved, in case you inadvertently write over it or make some other mistake. This is all done automatically.

Another nice time-saving measure is the use of the Commodore key in conjunction with another single key to perform certain formatting commands, such as indent and beginning a new line. These additions are a great help, especially when entering a long and complex document.

Finally, I have to give the people at TOTL software an A plus for user support. My frequent questions and concerns were answered promptly and accurately.

What I Didn't Like...

The lack of a global search function is the only major drawback in the system. Of minor concern is the slight delay between lines when printing, and the need to change from edit mode to the main menu every time you want to do something like save or print a file.

Summary...

If a well-known consumer magazine reviewed word processors (as they no doubt will do someday), this would clearly be a "best buy." Given the price and the capabilities of the system, it may be the only word processor you'll ever need.

WordPro 3 Plus/64

WordPro 3 Plus/64 (Professional Software, Inc., 51 Freemont St., Need-

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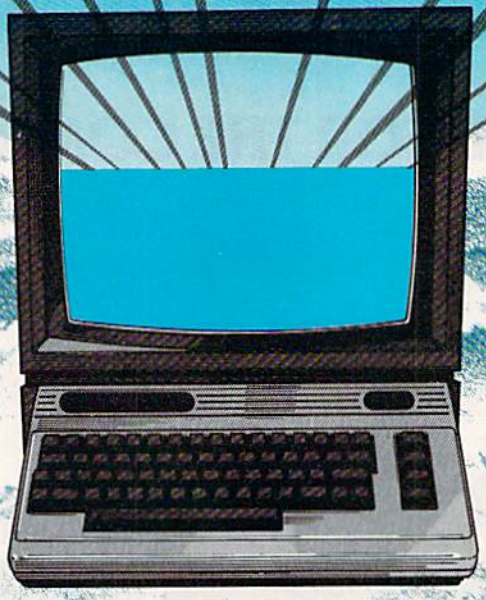

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ham, MA 02194; $79.95) is a disk-based word processor that is currently the most popular of the high level packages designed for the Commodore 64. It has virtually all the functions you would ever need, including automatic file/letter merge, plus other capabilities usually found only in packages designed for much more expensive computers.

After WordPro is loaded, you are asked to answer a series of questions about the system's printer requirements and the number of lines you want available for the main work area. WordPro will then display a status line that indicates the mode you are in, as well as the column and line number where the cursor is located.

The modes are extra text, insert, shift lock (types all caps), control mode and numeric mode. You enter and exit these modes by using the control key in conjunction with some other key. You enter all format commands on a separate line indicated by a control "?".

What I Liked...

One of the outstanding features of this program is the main and extra text work areas. Here you can enter text in the main area, and then switch to extra text to enter material you want to merge with the information in main text.

This is especially handy (and very easy to use) for writing multiple copies of letters that have different greetings, as well as different phrases within the document itself. WordPro also allows you to merge and print these separate sets of information continuously. With continuous-form stationery becoming more popular, this is an especially convenient feature.

Another attractive feature of WordPro is the convenience of the delete feature, which highlights and then can delete lines, blocks and even sentences, with one keystroke.

The documentation is extensive and more thoroughly prepared and thought through than that of any other word processor I have seen. The 8½- by 11-inch manual (which is 3-hole punched for added convenience) is well organized and includes a complete index and a quick reference section. With a bit of study time, you can find the answer to almost any question you might have.

What I Didn't Like...

There was very little I didn't like about WordPro. One significant shortcoming is the lack of video formatting, so you can't see the format until it's printed. Also, WordPro does not do footnotes.

The price is a bit high and may put off some potential users. They should realize, however, that in software, as in everything else, you get what you pay for.

Don't be caught up in the notion that expensive is good. Buy a word processor that meets your needs, at what you believe is a fair price.

Summary...

WordPro 3 Plus/64 is as complete a word processor as you need. It performs all the necessary functions and is relatively easy to learn, given all that it can do.

Easy Script 64

Easy Script 64 (Commodore Business Machines, 1200 Wilson Drive, West Chester, PA 19380; $99.95) was initially distributed on disk, while current versions are available in cartridge form. Easy Script is an assembly language program, written in England and patterned after WordPro.

Format commands are embedded directly in the text and generally consist of a two-letter command, plus any parameters. You initiate most format and editing commands by pressing F1, or some other function key, followed by the command. Multiple commands can be combined on a single line.

What I Liked...

You can easily switch between viewing on the screen and printing of formatted output. This is extremely handy when you only need a page or two somewhere in the middle of a document.

You can view documents wider than 40 columns and scroll horizontally as well as vertically. You can use tape or disk to save documents, and you can save tab settings as well.

Another nice feature is the ability to generate special printer controls for underlining, subscripts, ribbon color changes and variable line or character print as supported by your particular printer. You can generate any ASCII character code, as well as special escape sequences to accommodate just about any printer that can be connected to your system.

Easy Script also directly supports the reading and writing of standard sequential data files. These are normally used for filling variable blocks when writing such things as form letters. Other than disk capacity, there's no limit to the size of the data files, and they can easily be generated by other programs for use by Easy Script.

What I Didn't Like...

The disk version is copy protected, so you cannot make backup copies. However, two copies of the disk are included in the package.

A small quick reference guide card is supplied, but there's no comparable section in the manual, as there is with the CBM version called Superscript.

Summary...

An excellent, full-function word processor for any level of user, Easy Script lives up to its name by handling documents of any size with ease.

Paper Clip

Paper Clip (Batteries Included, 186 Queen St. West, Toronto, Ontario, Canada M5V 1Z1; $125) is another machine language word processor patterned after WordPro. It includes a number of enhancements and changes, including special functions to deal with columns of items in tables.

As usual, format commands are embedded in the text. Each command line is initiated using the pound key. Function keys F2, F4 and F6 are used to select screen colors.

The disk is not copy protected, so you can make backup copies. However, a protection key supplied with the program must be inserted in the front joystick connector for the program to function.

What I Liked...

The special functions for handling columns are a very handy addition. Besides moving, inserting and deleting columns, you can also add or sort a column.

A special program is included to generate a printer control file that allows customizing the program for just about any printer. The options are endless, and a separate manual is provided for this program.

What I Didn't Like...

The only comment I can make concerns the manual. The copy in the pack-

age I received was missing two pages, and there appeared to be several places where a few lines were missing. However, the manual was still perfectly usable and I did not have trouble with it.

Summary...

Paper Clip is another excellent, full-function word processor for all levels. The additional column functions are ideal for writing reports.

Writer's Assistant

Writer's Assistant (Rainbow Computer Corp., 490 Lancaster Ave., Frazer, PA 19355; $69.95) uses both Basic and machine language with several program overlays. When selecting functions from the main menu, there is a considerable pause while the next program is loaded from disk.

Format commands are embedded in the text, using the Commodore key to initiate each command. You use the control key to initiate all immediate commands and the function keys to provide special scrolling operations.

The disk is not copy protected, and no protection key is required. Demo programs and help keys are included.

What I Liked...

There's an immediate command that will count the number of words in your document. There's also a special command that lets you retrieve recently deleted material up to 256 characters.

When creating a new document, besides giving a document or file name, you can also specify an author's and operator's name, along with an up to 40-character comment.

What I Didn't Like...

When you enter text, quite a lot of sparkles are generated on the screen. Input response is slow and it's easy to delete too many characters when holding the delete key. Actually, the delete key doesn't delete characters as you would expect; it merely erases them and replaces them with spaces. A special Delete command must be invoked to fully clean up the screen.

If you enter an incorrect file name when attempting to print a document, the program displays the file-not-found error and asks if you want to retry or bypass. Bypass does not exit the print function and return to the main menu. You must enter a valid file name once the print function has been started. You also cannot display the disk directory nor abort the print function at that point.

If you attempt to print a document with no printer attached, the program aborts. When using tabs, you can only set a maximum of nine within the width of your document.

Summary...

Writer's Assistant is usable for a casual need, but not powerful enough for a serious user.

Script-64

Script-64 (Pacific Coast Software, 3220 South Brea Canyon Road, Diamond Bar, CA 91765) is an assembly language program that uses an unusual approach. Instead of providing a scrolling display while editing and inserting text, this program restricts you to screens of 22 lines.

Each file consists of 40 screens and each disk can hold only 999 files. With this structure, you typically write one paragraph per screen to allow room for future expansion and editing.

Formatting is controlled by one global control map, while there is a special small map associated with each screen for local control. When printing a document, you must specify all the screens you want included, in the order they are to be printed. In doing this, you can use ranges of numbers for convenience.

The disk is not copy protected, but a protection key supplied with the program must be inserted in the front joystick connector for the program to function.

What I Liked...

Script-64 will also work with the C-64

Before You Shop Around...

A word processor can be an exciting addition to your system. As you discover and consider different word processors, use the following questions as a guide to help you decide which is best for you.

How easy is it to use? For the most part, you cannot check out a word processor from your dealer, as you would a book from the library, and take it home to try it. But you can talk to other people with systems similar to yours, who have a certain type of word processor, and find out how easy they think it is to use.

You should expect a dealer at least to give you a demonstration and let you see the documentation (which can tell you a lot about how hard it will be to learn).

Remember that a sophisticated word processor does not have to be a difficult one. It may take some time to master, but as long as the documentation is clear, it will be well worth the effort.

What do the reviews say? By the time a word processor reaches your dealer, or even by the time it is advertised in the popular computing magazines, it has probably been critically reviewed.

Read these reviews in an effort to come to a balanced and informed decision about the program. Don't ignore informal reviews and shop-talk that you can pick up at your dealer. Even if you need a word processor on short notice, you would do well to do your homework.

What does it cost? Don't be caught up in the notion that expensive is good. There is wide variation in price among word processors, with prices changing all the time.

You should buy the word processor that does the things that you need, at what you believe is a fair price. Remember that many months of development go into the design of these programs, and the amount of time and money you save in your own work is worth the investment.

Will it do what you need? You know your own needs better than anyone else. If you only want to write short memos, perhaps a simple word processor is best. If you need certain printer options and controls, you should be aware that not all word processors have equal capability. Come prepared with a list of what you want your word processor to do, and check it against the features of the various programs as listed in their instruction manuals.

Is it compatible with the rest of your system? Sometimes, in your excitement, you may choose a new piece of equipment or software without checking to see if it will fit your system. Read the documentation that comes with the word processor.

If your questions are not answered, ask your dealer or contact the publisher. If you don't receive an

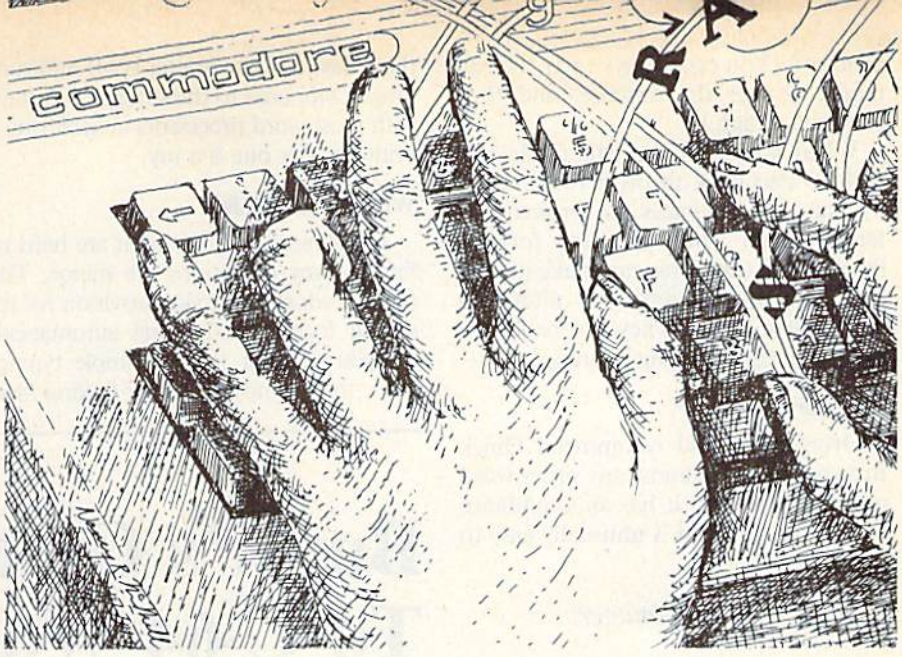
Link cartridge from Richvale Telecommunications (Canada). This adapter allows you to use IEEE peripherals with the Commodore 64. The combination of Script-64 and the C-64 Link allows you to use IEEE or serial bus printers and disk drives in any combination.

Script-64 includes facilities for building a spelling dictionary and checking spelling on your documentation.

What I Didn't Like...

I found the screen-based file structure much slower to use than scrolling-type word processors. It just seems too slow to review one paragraph at a time on the screen.

When a word with more than six characters appears at the end of a line, it is automatically hyphenated, but not always correctly. Also, there is no index or command summary in the manual.



Summary...

The disadvantages of the fixed-size screens within a file may be more of a hindrance than a help. It makes the "pasting" together of pre-written sections extremely easy, but long documents are difficult to work with.

Quick Brown Fox

The Quick Brown Fox (548 Broadway, Suite 4F, New York, NY 10012; $75) is one of the easiest word processors to use, yet it has the capabilities of more sophisticated programs. It is cartridge-based, which makes starting simple and fast. It is menu-driven with simple (even colloquial) options like type, view, print and zap memory. It will store text on tape or disk. It has boilerplating, headers, global search and replace, embedded commands, underlining and justification. It even allows sending and receiving text via modem.

There are many more options, but even if you're a novice, you don't need to know any of these in order to use Quick Brown Fox. At the menu, press 'T' for type and begin typing. When you're finished, press the left arrow (called the escape key) and you're back to the main menu. (The escape key works in all situations, which means that if you think you did something incorrectly, just press it until you are back at the main menu.)

At each point in printing, saving, editing and so on, there are default values. For example, if you don't know how to use the various printing options, repeated pressing of the return key will eventually print your document.

Editing is done either from the edit mode or in the type mode. In the type mode, you make changes (only on the line you are typing; it is not a full screen editor) by using the arrow keys or the insert/delete keys. The manual recommends that you ignore mistakes on the first draft and then go back later to edit.

In the edit mode, the commands are one- or two-key instructions. For example, you position the cursor, then press I to insert new text, D to delete a letter, DW to delete a word, DS to delete a sentence and R to replace text.

This may seem a bit awkward at first, but the simple commands and relatively few instructions make editing with Quick Brown Fox much easier than with other word processors.

What I Liked...

The ease of use and simplicity of the commands are the finest points of this program. It shows that someone spent a lot of time developing the Quick Brown Fox from a user's standpoint rather than that of a computer programmer.

The manual is clear and straightforward, so deceptive in its simplicity that it seems there should be much more to it. (It almost makes Quick Brown Fox appear less powerful than some other word processors, but this is not so.)

The escape key is a nice touch. You may never need to back out of a particular menu, but knowing you can makes Quick Brown Fox less intimidating to use.

What I Didn't Like...

Not having a full screen editor in the type mode can be frustrating, but if you don't mind staring at a mistake until you're ready to edit, it isn't that big a

informative and helpful response, it's doubtful that you'd get the support you may need later on, and perhaps you should look to another program.

How compatible is it with other computers? You might not be interested now, but you may be changing computers as machines become more powerful and less expensive. You may not want to spend a lot of money on a word processor that you will not be able to use with another operating system.

On the other hand, the cost of a decent word processor might be such that you can use it for a few years and then sell it along with the rest of your outdated system.

How convenient is it to use? Whether it is easy to learn and use has nothing to do with convenience. For example, you can just plug in word processors that are on a cartridge, turn on the machine, and you are ready to go.

With a disk, you have to load and initialize, and this can be bothersome, especially if you want just to print out a short note. Some disk-based processors take as long to load (up to three minutes) as short notes take to type!

Also, to operate properly, some word processors require additional memory space, which can mean a hidden and sometimes higher cost than the word processor itself. So be sure to check that out before you buy.

N.J.S.

problem. (You can always enter the edit mode, change the mistake, and then continue typing.)

When you're in the edit mode and wish to step back through the text line by line, the sentences are broken differently than when you step forward through the text. This can make it difficult to recognize sentences after you have edited them. They are really the same, but the breaking is strange.

Summary...

Overall, I would recommend Quick Brown Fox over almost any other word processor I know. It has an abundance of fine features and is unusually easy to master.

Wordmanager

Wordmanager is a word processing program for the Commodore 64 from Data 20 (23011 Moulton Parkway, #B10, Laguna Hills, CA 92653; $29.95). The program comes on a tape cassette and is free if you purchase Data 20's VideoPak 80 cartridge ($93.57), which converts the Commodore to a 40/80 column screen format, contains a terminal emulation package for communication and makes possible the execution of larger PET programs on the C-64.

On the whole, I found Wordmanager a real surprise package, versatile and easy to use. I did encounter some difficulty with the initial set-up, for the manual is unclear on how to save the cassette program to disk.

As I finally discovered, the way to do it is to use the load command found in the C-64 manual—but do not run the program. Instead, enter SAVE"64wp", 8, and the program will be stored on the disk. After you have done this, load and run the program from the disk, place the function key strip on the keyboard and go to work.

What I Liked...

When Wordmanager is used in conjunction with VideoPak 80, you get what you see. It provides an 80-column screen, with a highlighted format line at the top. You get left and right margins and tabs that can be changed at will by using the F1 and zero key sequence, along with the period key to delete the stops you don't want.

Spacing is also easy. Just use the shift and INST/DEL keys, and you'll find that double or triple line spacing is simpler than on a typewriter.

The greatest delight of the program, however, is the ease of getting to the printer. You simply press the F1 key and the 2 key, and the printer is off and running. Compared to the struggle you have with most word processors in achieving a printout, this one is a joy.

What I Didn't Like...

The flaws in this program are hard to find, so my objections are minor. The program does not make provision for inserting footers or headers automatically—you do that job by simple typing. Also, there is no option for linking files. (The program does, however, have a simple search and replace function.) Another drawback is that you cannot hyphenate automatically. Consequently, the right edge is more ragged than you might want—yet it's not unacceptable.

Summary...

All in all, I think that Data 20 has a quality product that can help make the C-64 even more user-friendly than it already is. R

Buyer's Guide To C-64 Word Processing

Manufacturers' Addresses

Busiwriter 64

Skyles Electric Works
231E South Whisman Road
Mountain View, CA 94041

HESWRITER 64

Human Engineered Software
71 Park Lane
Brisbane, CA 94005

Wordcraft 64

United Microware Industries, Inc.
3503 Temple Ave.
Pomona, CA 91768

TOTL.TEXT 2.6

TOTL Software, Inc.
1555 Third Avenue
Walnut Creek, CA 94596

Word Pro 3 Plus/64

Professional Software, Inc.
51 Freemont St.
Needham, MA 02194

Easy Script 64

Commodore Business Machines, Inc.
1200 Wilson Drive
West Chester, PA 19380

Paper Clip

Batteries Included
186 Queen St. West
Toronto, Ontario, Canada M5V 1Z1

Writer's Assistant

Rainbow Computer Corp.
490 Lancaster Pike
Frazer, PA 19355

Script-64

Pacific Coast Software
3220 South Brea Canyon Road
Diamond Bar, CA 91765

Wordmanager

DATA 20
23011 Moulton Parkway
Suite B10
Laguna Hills, CA 92653

Quick Brown Fox

Quick Brown Fox
548 Broadway, Suite 4F
New York, NY 10012

Bliztext

Elcomp Publishing
53 Redrock Lane
Pomona, CA 91766

Mirage Concepts

Mirage Concepts
2519 W. Shaw #106
Fresno, CA 93711

Smithwriter and Wordsmith

Softsmith Corp.
1431 Doolittle Drive
San Leandro, CA 94577

Insta Writer

Standun Controls, Inc.
2158 S. Hathaway St.
Santa Ana, CA 92705

Additional Features

Wordcraft 64

1. Performs block delete, block move and block reproduce.
2. Mail list files included for boilerplating.
3. Dynamic formatting, always viewing print format (no intermediate step).

TOTL.TEXT 2.6

1. Prints multiple copies.
2. Prints documents of any length.
3. Comes complete with detailed documentation written in a reference style; a separate tutorial and a sample text file are also included.
4. Full customer/technical support.

Wordmanager

1. Feature strip keyboard overlay.
2. All commands one-key simple; no commands to remember.
3. Fast half-screen scrolling.
4. Printer configuration, storage type, margins, tabs, page counter, column counter and line counter indicated on two status lines.

Quick Brown Fox

1. Telecommunication features available from main menu.

Bliztext

1. Terminal mode with upload and download.
2. Single keystroke for disk directory.
3. Single keystroke for error channel.

Mirage Concepts

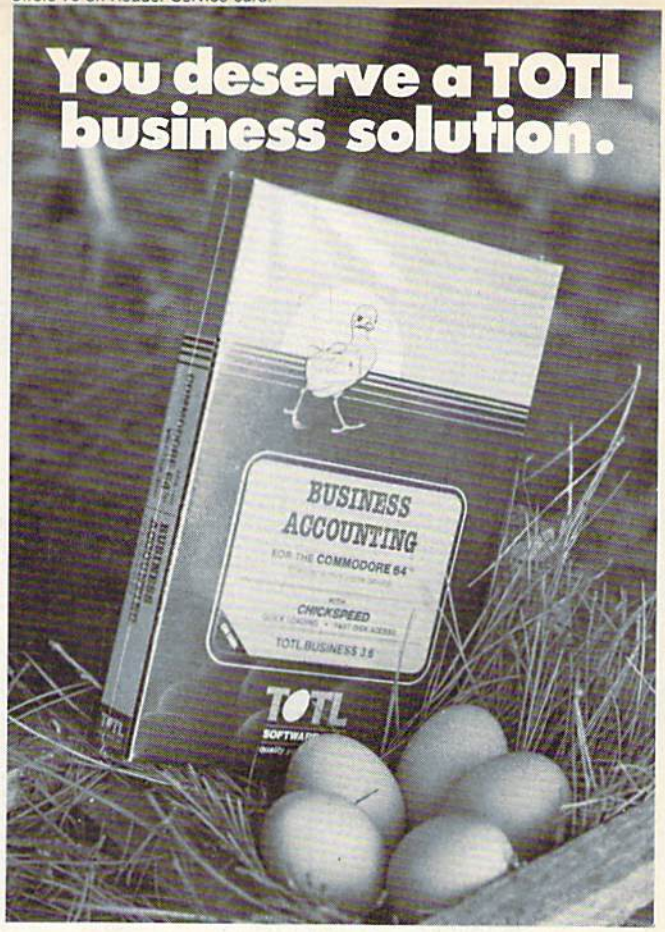
1. Column movement.
2. 80-column screen, no hardware required.
3. Save block.
4. Print block.
5. Delete file.
6. True word wrap.
7. Automatic formatting.

Smithwriter

1. Line-oriented word processor designed for home.
2. A list of commonly-used operations and their function keys is always displayed at bottom screen.
3. Other menus cover file input and output, printing, and a one-time setup of the program to tell it what equipment you have and what colors you prefer.
4. Provides multi-column text.
5. Deletes by block.

On the following four pages, we present a chart of features for the major C-64 word processors. This chart was compiled from information supplied to us by the manufacturers. Additional features that could not be easily placed in the chart are shown above.

Circle 70 on Reader Service card.



WORD PROCESSING
TOTL.TEXT

MAILING LIST AND LABELS
TOTL.LABEL

TIME MANAGEMENT
TOTL TIME MANAGER

KEYWORD CROSS REFERENCE
RESEARCH ASSISTANT

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TOTL.SPELLER (64 only)

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quality you can afford

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PLEASE SEND ME MORE INFORMATION ON TOTL SOFTWARE

Name: _____

Address: _____

_____ Zip _____

	Buswriter 64	HESwriter 64	Wordcraft 64	TOTL.TEXT 2.6	Word Pro 3 Plus/64	Easy Script 64	Paper Clip	
Edit Features								
Printer Control	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Insert By line	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
By block	No	No	Yes	Yes	Yes	Yes	Yes	
Search	Yes	Yes	Yes	No[1]	Yes	Yes	Yes	
Search and Replace	Yes	No	Yes	No[1]	Yes	Yes	Yes	
Preview Text on Screen	Yes	Yes	Yes	Yes	No	Yes	Yes	
File Merge	Yes	No	Yes	Yes	Yes	Yes	Yes	
Pagination	No	Yes	No	Yes	Yes	Yes	Yes	
Heading/Footing	Yes	No	No	Yes	Yes	Yes	Yes	
Horizontal Scrolling	Yes	No	Yes	Yes	Yes	Yes	Yes	
Vertical Scrolling	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Delete By word	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
By line	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
By sentence	Yes	No	Yes	Yes	Yes	Yes	Yes	
By paragraph	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
By screen	Yes	Yes	Yes	No	Yes	Yes	Yes	
Read from disk/tape	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Write to disk/tape Save	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Replace (Rename)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
By lines	No	Yes	No	No	Yes	Yes	Yes	
Copy and move Lines	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Block	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Use of function keys	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Use of coded file	No	No	Yes	No	No	—	—	
Link Files	Yes	Yes	No	Yes	Yes	Yes	Yes	
Display Directory	Yes	No	Yes	No[1]	Yes	Yes	Yes	
Validate disk	Yes	No	Yes	No[1]	Yes	Yes	Yes	
Initialize disk	Yes	No	Yes	No[1]	Yes	Yes	Yes	
File length	16-20 pgs.	6 pages	7 pages	6 pages	7 pages	764 lines	—	
Keyboard input	Yes	—	No	Yes	Yes	Yes	Yes	
Merge from disk	Yes	No	Yes	Yes	Yes	Yes	Yes	
Auto Input (Boilerplating)	—	—	Yes	—	—	—	—	
Auto Insert	—	—	Yes	—	—	—	—	

[1]Yes, in enhanced version to be announced.

[2]$40 on tape.

[3]Three years on four-column Commodore, one year on C-64.

[4]Sixty-six lines only.

	Writer's Assistant	Script 64	Word Manager	Quick Brown Fox	Bliztext	Mirage Concepts	Smithwriter	Wordsmith	Insta Writer
	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	No	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes
	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	No
	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No
	No	Yes	Yes	Yes	Yes	Yes	No	No	—
	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	No
	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes
	Yes	Yes	No	Yes	No	—	No	No	No
	No	No	No	No	Yes	Not Needed[6]	No	No	No
	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Yes	Yes	No	Yes	Yes	Yes	No	No	No
	No	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes
	No	Yes	Yes	Yes	No	Yes	No	No	No
	No	Yes	Yes	Yes	No	Yes	No	No	No
	No	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes
	Yes	Yes	Yes	Yes	Yes	Disk	Both	Both	Yes
	Yes	Yes	Yes	Yes	Yes	Disk	Both	Both	Yes
	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes
	Yes	No	No	Yes	No	No	Yes	No	No
	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes
	—	—	No	Yes	No	—	No	No	—
	Yes	No	No	Yes	Yes	Yes	No	No	Yes
	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Yes	No	No	Yes	No	No	No	No	No
	Format Only	Format Only	Yes	No	Yes	Yes	No	No	Yes
	350 lines	40 screens	7 pages	38,000 chars.	—	—	7 pages	10 pages	1 page
	No	No	Yes	Yes	Yes	Yes	—	—	Yes
	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	No
	—	—	—	Yes	No	Yes	No	No	—
	—	—	—	Yes	No	Yes	No	Yes	Yes

[5]Free with 80-column board.

[6]Eighty columns in software.

[7]$54.95 on tape.

	Busiwriter 64	HESwriter 64	Wordcraft 64	TOTL.TEXT 2.6	Word Pro 3 Plus/64	Easy Script 64	Paper Clip
Format Features							
Center Text	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Justification	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Change margins	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Line Spacing	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Set Page Length	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Indent	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Tabs	Yes	No	Yes	Yes	Yes	Yes	Yes
Force New Page	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Force New Line	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Preserves Hyphenation	No	No	Yes	Yes	Yes	Yes	Yes
Footnotes	Yes	No	No	Yes	Yes	Yes	Yes
Numerical Tab	Yes	No	Yes	Yes	Yes	Yes	Yes
Comment line	No	No	Yes	No	Yes	Yes	Yes
Pause	Yes	No	No	Yes	Yes	Yes	Yes
Save Print Format	—	—	Yes	—	Yes	—	—
Other							
Index	No	—	No	—	Yes	Yes	No
Disclosure statement	Yes	No	Yes	Yes	Yes	Yes	—
Change Screen Colors	Yes	No	Yes	Yes	Yes	Yes	Yes
Audio Feedback	No	Yes	Yes	No	Yes	Yes	No
Column add/subtract	No	No	No	No	Yes	No	Yes
Additional work areas	Yes	No	No	No	Yes	No	No
Status Line	Yes	No	Yes	No	Yes	Yes	Yes
Price	$69.00	$39.95	$149.95	$44.00[2]	$79.95	$99.95	$125.00
Years Available	1	1	1	2	See [3]	1	—
Medium	Disk	Cartridge	Cartridge	Disk/Tape	Disk	Disk/Tape	Disk
Use without a printer?	Yes	Yes	Yes	Yes	Yes	Yes	Yes

[1]Yes, in enhanced version to be announced.

[2]$40 on tape.

[3]Three years on four-column Commodore, one year on C-64.

	Writer's Assistant	Script 64	Word Manager	Quick Brown Fox	Bliztext	Mirage Concepts	Smithwriter	Wordsmith	Insta Writer
	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	No
	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
	Yes	Yes	Yes[4]	Yes	Yes	Yes	Yes	Yes	No
	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	No
	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes
	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	No
	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes
	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	No	No	No	No	No	Not Auto.	No	No	No
	No	Yes	No	Yes	Yes	Yes	Yes	No	No
	No	Yes	Yes	No	No	No	No	No	No
	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No
	—	—	—	Yes	Yes	Yes	No	Yes	No
	Yes	No	No	Yes	No	Yes	No	No	Yes
	—	—	No	Yes	No	Yes	Yes	Yes	—
	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes
	No	No	No	No	Yes	Yes	—	No	No
	No	No	No	No	No	No	No	No	No
	No	No	No	No	Yes	No	No	Yes	Yes
	No	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes
	$69.95	$105.00	$29.95[5]	$75.00	$89.00	$99.95	$59.95[7]	$59.95[7]	$51.95
	—	—	4 mos.	1	3 mos.	New	3 mos.	New	6 mos.
	Disk	Disk	Disk/Tape	Disk/Cart.	Disk/Tape	Disk	Disk/Tape	Disk/Tape	Cart.
	Yes	Yes	—	Yes	Yes	Yes	Yes	Yes	Yes

[4]Sixty-six lines only.

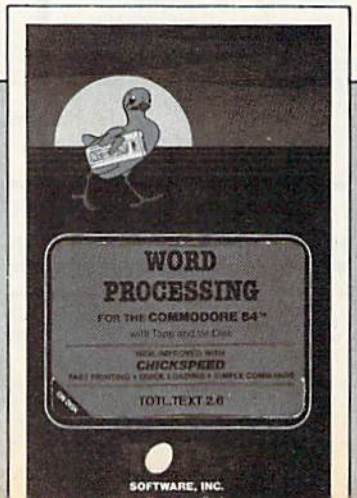
[5]Free with 80-column board.

[6]Eighty columns in software.

[7]$54.95 on tape.

←Quick as a fox, easy to use, with an abundance of features (left).

←Learn to use this word processor in an "insta" or two (right).



The TOTL word processor for your C-64←.

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(* with software savings applied)

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(a real computer at the price of a toy)

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- VOICE SYNTHESIZER $59.00

(* with Cassette and Gortek purchase)

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You pay only $199.50 when you order the powerful 84K COMMODORE 64 COMPUTER! LESS the value of the SPECIAL SOFTWARE COUPON we pack with your computer that allows you to SAVE OVER $100 off software sale prices!! With only $100 of savings applied, your net computer cost is $99.50!!

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When you buy the Commodore 64 Computer from Protecto Enterprizes you qualify to purchase ONE SOFTWARE BONUS PACK for a special price of $29.95!! Normal price is $49.95 (40 programs on disk or 24 programs on 5 tapes).

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You pay only $219.00 when you order the Comstar T/F deluxe line printer that prints 8 1/2 x 11 full size, single sheet, roll or fan fold paper, labels etc. 40, 66, 80, 132 columns. Impact dot matrix, bi-directional, 80 CPS. LESS the value of the SPECIAL SOFTWARE COUPON we pack with your printer that allows you to SAVE OVER $100 off software sale prices!! With only $100 of savings applied your net printer cost is only $119.00.

80 COLUMN BOARD $149.00
You pay only $149.00 for this 80 Column Board. Included with this board is word processor pack, electronic spread sheet and mail merge data base on two tapes. List $249.00. (Disk add $10.00).

80 COLUMN WORD PROCESSING PACKAGE $79.00
SCRIPT 64 EXECUTIVE WORD PROCESSOR is the finest available for the COMMODORE 64 Computer! THE ULTIMATE for PROFESSIONAL wordprocessing application. DISPLAYS 80 COLUMNS IN COLOR. Featuring simple operation, powerful text editing with a customized 250 word dictionary, complete cursor and insert/delete key controls, line and paragraph insertion, automatic deletion, centering, margin settings and output to all printers. Included is a powerful MAIL MERGE When used with THE COMPLETE DATA BASE PACKAGE. List $99.00. Sale $79.00. Coupon Price $52.00. (Disk only).

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We pack a SPECIAL SOFTWARE COUPON with every COMMODORE 64 COMPUTER-DISK DRIVE-PRINTER-MONITOR we sell! This coupon allows you to SAVE OVER $100 OFF SALE PRICES! $200-$300 savings are possible!! (example)

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Accounting Pack	$69.00	$32.00
Total 5.2 Word Processor—Plus		
Tape	$69.00	$37.00
Disk	$79.95	$42.00
Total Text 2.6 Word Processor—		
Tape	$44.95	$26.00
Disk	$49.95	$26.00
Total Label 2.6	$24.95	$12.00
Disk	$29.95	$15.00
Quick Brown Fox Word Processor	$69.00	$40.00
Programmers Reference Guide	$20.05	$12.50
Programmers Helper	$69.00	$40.00
Basic Tutor	$29.95	$15.00
Typing Teacher	$29.95	$15.00
Sprite Designer	$16.95	$10.00
Medicinemen	$19.95	$12.00
Weather War II	$19.95	$12.00
Music-Maker	$19.95	$12.00
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Sales Analysis	$89.00	$69.00
General Ledger	$89.00	$69.00

(*COUPON PRICE $59.00)

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You get the Commodore VIC-20 Computer for only $77.00 when you buy at sale prices: The Commodore Data Cassette for only $69.00 and the Gortek Introduction to Basic program for only $19.95. TOTAL LIST PRICE $302.95. SPECIAL PACKAGE SALE PRICE $165.25.

40-80 COLUMN BOARD $89.00
A fantastic price breakthrough for VIC-20 owners on this most wanted accessory!! "Now you can get 40 or 80 Columns on your T.V. or Monitor Screen." Plus we add a word processor with mail merge, electronic spread sheet, time manager and terminal emulator!! These PLUS programs require 8K or 16K RAM memory. (Disk add $10.00).

VOICE SYNTHESIZER $59.00
Votrax Based. Make your VIC-20 COMPUTER TALK! Has features equivalent to other models costing over $370.00. You can program an unlimited number of words and sentences and even adjust volume and pitch. You can make adventure games that talk! A must for enhancing your programming creativity and pleasure.

60K MEMORY EXPANDER $59.00
Sixslot — Switch selectable — Reset button — Ribbon cable. A must to get the most out of your VIC-20 Computer. Includes FREE $29.95 adventure game.

8K RAM CARTRIDGE $39.95
Increases programming power 2 1/2 times. Expands total memory to 33K (33,000 bytes). Memory block switches are on outside of cover! Includes FREE $16.95 game.

16K RAM CARTRIDGE $69.00
Increases programming power 4 times. Expands total memory to 41K (41,000 bytes). Memory block switches are an outside cover! Includes FREE $29.95 adventure game!!

12" GREEN SCREEN MONITOR $99.00
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Double Your Pleasure
With Conversion Magic

Do you feel left out because you have a Commodore 64, but not enough software for it? Here's an article that tells you how to convert those many VIC-20 programs to run on the C-64.

By Robert E. Black, Jr.

My interest in converting programs was initially spurred by the lack of Commodore 64 programs and the wide availability of them for the VIC-20. My secondary reasons were to obtain a better understanding of the Basic language and to study the programming techniques that are used for animation. Whatever your reasons, you first have to select a program to convert.

Naturally, the best way to choose a program is first to see it operate on a VIC-20. Whether or not this is possible for you to do, once you have made a selection, enter the VIC program on your C-64 exactly as listed, and save it before you run it.

This is your starter program. If you can check it on a VIC, do so, and if you detect bugs, make a note of the statement numbers. It is probable that the same bugs will occur on the C-64.

If a C-64 you have got,
But sufficient programs you've not,
Then take some of the VIC's
And convert them with tricks—
Hey, this article gives you a lot!

Principal Program Differences

The VIC-20 and C-64 computers are similar in many respects, but there are differences in the methods they employ to control registers used to produce screen and sound action. The keyboard and joystick reading procedures are also different. (See Tables 1 and 2 for summaries.)

You control the screen characters and the character colors of each computer with either Print or Poke statements. The Print statements on a VIC will print on a C-64 screen, with only the minor changes required by the screen size difference. Normally, a change is required if a semicolon terminates a Print statement, since it will wrap around differently on the wider C-64 screen.

You always have to modify the Poke statements to adjust the VIC memory location to its equivalent C-64 location. I have developed a simple program (Listing 1) that converts the VIC character location to a C-64 location. You can determine the character color Poke location by adding

```
1000 PRINT"[SHFT CLR]":REM*********VIC TO C-64 SCREEN A
     DDRESS CHG
1010 POKE53281,1:FLAG=0:VA=0:INPUT"[COMD 4]VIC-20 ADDRE
     SS";VA:IFVA=OTHENSTOP
1011 IFVA<7680 THENPRINT"[CTRL 9] ADDRESS TOO LOW ":GOT
     O1010
1012 IFVA>8185 AND VA<38400 THENPRINT"[CTRL 9] ILLEGAL
     ADDRESS ":GOTO1010
1013 IFVA>38905 THENPRINT"[CTRL 9] ADDRESS TOO HIGH ":G
     OTO1010
1015 IFVA>38399 AND VA<38906 THENVA=VA-30720:FLAG=1
1020 RO=INT((VA-7680)/22)
1030 CO=VA-7680-(22*RO)
1040 CA=1024+RO*40+CO:IFFLAG=1THENCA=CA+54272
1050 PRINTTAB(21)CHR$(145);" C-64 ADDRESS";CA:GOTO1010
```

Listing 1. A program that converts a VIC-20 character location to a C-64 location.

RUN It Right
Commodore 64

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an offset to the character location. The VIC offset is 30720 and the C-64 offset is 54272.

The screen border and background colors on the VIC are controlled by a single register, whereas the C-64 uses two registers to control the colors. The pattern of the color progression of Pokes used by the VIC is the more complicated. The lowest Poke value is 8 and represents a black background with a black border.

As this value increases by one, the border color increases by one in the keyboard color-key order (black through yellow). To increase the background color by one (in the order shown in Table 1), an increment of 16 is required. For example, 24 produces a black border and white background; the highest Poke, 255, produces a light yellow background and a yellow border.

Since the C-64 color Poke codes are constant (0–15), the effect is immediately seen when each color number is Poked into the two registers. When the C-64 border register is Poked with a zero, a black border is seen.

The VIC-20 and C-64 also produce sounds in different ways. The VIC has four registers dedicated to sound. Three of the voices are musical, each having a particular frequency range, while the fourth voice produces random noise. The VIC voices can be either on or off, and are primarily controlled by master volume and frequency settings (128–255).

The C-64 features a full sound synthesizer with three voices. Each voice can produce noise or music. The exact sound produced is controlled by volume, frequency, waveform, attack/decay and sustain/release settings. The degree of control possible exceeds that required for most games or programs.

Input Differences

The keyboard layouts of the two computers are physically identical, but when you depress a particular key, the registers storing that information (locations 197 and 203) contain different values. Since most programs read the keyboard, program changes are required to produce the desired effect. It is a simple matter to change the If statement used to sense the depressing of a particular key. The VIC and C-64 values for keys normally used are presented in Table 2.

The differences in joystick reading techniques of the two machines are best described by presenting examples of typical program applications. Dr. Dementia, a program I converted for publication in the August 1983 issue of *Microcomputing*, is one such example.

This program uses the joystick essentially as a paddle, left and right motion only. Similar programming can be used for motion in any of the eight directions. The statements from the original VIC and the converted C-64 programs are shown below.

```
VIC   POKE 37154,127: PK = PEEK(37152)
      AND 128: J0 = -(PK = 0): POKE
      37154,255: PK = PEEK(37151): J2 =
      -((PK AND 16) = 0): FB = -((PK
      AND 32) = 0)
C-64  JV = PEEK(56320) AND 15: FB =
      -((PEEK(56320) AND 16) = 0)
```

The first VIC Poke sets one of the two data-direction registers to an input mode. This enables switch 3 (right) of the joystick to be read and ANDed to establish a value for PK. If

Screen character layout:

VIC	22 columns × 23 rows
C-64	40 columns × 25 rows

Screen background and controls:

VIC	Sixteen (black, white, red, cyan, purple, green, blue, yellow, orange, lt. orange, pink, lt. cyan, lt. purple, lt. green, lt. blue, lt. yellow) Control 36879 (8–255)
C-64	Sixteen (black through orange, brown, lt. red, gray 1, gray 2, lt. green, lt. blue, gray 3) Control 53281 (0–15)

Character and border colors and controls:

VIC	Eight (black through yellow) Border control 36879 (8–255)
C-64	Sixteen (all border and background colors) Border control 53280 (0–15)

Screen character and color memory maps (starting in upper left-most screen position):

VIC	Character 7680–8185 Color 38400–38906 Offset character to color 30720
C-64	Character 1024–2023 Color 55296–56295 Offset character to color 54272

Sound chip and controls:

VIC	Three music voices (Five octave total range: lowest 36874, middle 36875, highest 36876) One random noise voice 36877 Volume control 36878
C-64	Three voices (Eight octave total range) Controls: volume, frequency, waveform, attack/decay, sustain/release

Keyboard switch layout (See Table 2 for comparison)

Table 1. Principal differences between the VIC-20 and Commodore 64 computers.

the stick were moved to the right, J0 would be set to one through the logical AND statement. If the stick were stationary, J0 would be zero.

Since the data-direction register serves double duty on the VIC, you must reset or Poke it back to 255 after the read of switch 3 is completed. The other three switches of the stick are read by Peeking location 37151. By ANDing the value read with powers of 2, you can determine the status of the switches. If the Peek is ANDed with 4, the up switch is sensed. Similarly, ANDing with 8 and 16 senses down and left directions, respectively.

Diagonal motion is sensed when two switches are closed at the same time. The fire button motion is sensed by ANDing with 128. The logical statements for J2 and FB are examples of left direction and fire button sensing. The VIC has other registers to read the joystick, but those shown are generally used. The alternative registers are 37137 and 37139.

The C-64 joystick is read simply by Peeking one of two locations (56320 for Port 2; 56321 for Port 1). The Peeked value when ANDed with 15 yields 14, 13, 11 and 7, for up, down, left and right joystick motion, respectively. Diagonal joystick motion produces values of 5, 6, 9 and 10. The fire button is sensed by ANDing the Peek with 16.

The overall procedure for changing a VIC joystick program portion to operate on a C-64 is:

- Scan the listing for the registers discussed and the value they are ANDed with.
- Establish the program logic that uses the joystick input.
- Change the VIC statements to the simple C-64 equivalent statements.

A Sample Exercise

The best way to see how all these differences affect a typical program is through a conversion exercise. For the exercise, I have chosen a Public Domain game, Artillery, selected because the conversion changes are typical of most simple Basic programs. Listings 2 and 3 show the starter VIC and converted C-64 programs. Permission to use this game was granted by Bill Munch of Public Domain, Inc., West Milton, Ohio.

The approach taken yields a C-64 program that operates similarly to the VIC program. However, using the simple procedure described, the sounds produced by the C-64 SID (Sound Interface Device) do not exactly duplicate the VIC sounds. If better emulation is desired, the SID registers must be tuned, which may require adjusting the frequency, waveform, attack/decay and sustain/release controls.

The difficult part of conversions is following the flow of the program. VIC programmers with limited machine memory at their disposal use very few Remark statements. One method of tracing is to place a Stop before and after each branch statement (If, Go Sub, Go To, etc.) in the starter program. Then modify the statements before the Stops and remove them as you successfully pass each break with proper program action.

Artillery involves two players who shoot cannons over a randomly shaped mountain. To make the game more difficult, you must consider a wind factor when selecting the angle to fire your cannon. You must also adjust the load, or powder.

The lines or statements of the C-64 listing that are changed will be discussed in groups when common changes dealing with sound, screen, keyboard and so on are encountered.

Lines 0 and 75: The DEF function of line 0 is used throughout the program to Poke various graphic symbols into screen memory locations, according to the current values of X and Y. This DEF function could also have been used by the VIC programmer in line 75, but was not. The equation differences in both lines relate to the start of the screen character memory (VIC, 7680; C-64, 1024) and the number of rows and columns (VIC, 22 columns × 23 rows; C-64, 40 columns × 25 rows).

Line 4: This startup subroutine (lines 3500–3640) deals primarily with key registers and arrays. The first line establishes the memory limits of the SID registers and then initializes three variables (BO, BA, CU) to control the screen colors for the border, background and cursor. The next line clears the sound chip, SID, as recommended by Commodore.

The program proceeds to establish

Standard Keys

Row 1			Row 2			Row 3			Row 4		
Key	VIC	C-64	Key	VIC	C-64	Key	VIC	C-64	Key	VIC	C-64
←	8	57	Q	48	62	A	17	10	Z	33	12
1	0	56	W	9	9	S	41	13	X	26	23
2	56	59	E	48	14	D	18	18	C	34	20
3	1	8	R	10	17	F	42	21	V	27	31
4	57	11	T	50	22	G	19	26	B	35	28
5	2	16	Y	11	25	H	43	29	N	28	39
6	58	19	U	51	30	J	20	34	M	36	36
7	3	24	I	12	33	K	44	37	,	29	47
8	59	27	O	52	38	L	21	42	.	37	44
9	4	32	P	13	41	:	45	45	/	30	55
0	60	35	@	53	46	;	22	50			
+	5	40	*	14	49	=	46	53			
−	61	43	↑	54	54						
£	6	48									

Special Control and Function Keys

Key	VIC	C-64	Key	VIC	C-64
Clear—Home	62	51	f1	39	4
Insert—Delete	7	0	f3	47	5
Return	15	1	f5	55	6
Space Bar	32	6	f7	63	3
Cursor—Vertical	31	7	Cursor—Horizontal	23	2

Note: When no keys are depressed, a value of 64 is stored at locations 197 and 203.

Table 2. Keyboard switch layout differences between the VIC-20 and the C-64.

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VIP Terminal ready 11:15:46
Dear Pepper,

You're right. This VIP Terminal is the only terminal for the C 64 worth owning. That freebie software that came with my modem just didn't work, especially with my new smartmodem. The 80 column display alone was well worth the $49.95 - much less the 40, 64 and 106 character displays - and it doesn't need any hardware changes. Imagine 106 characters on 25 lines. Heck, there's more text on my screen than on my uncle's Apple or my dad's I B M - P C!

I put auto-dial to work right away. I auto-dialed Compuserve, but couldn't get through, so I had VIP Terminal redial 'til it got through - it dialed five minutes straight! Then I auto-logged on with one of my 20 programmed keys, and downloaded some graphics screens, and stock quotes for dad. I printed it and saved it to disk as it came on the screen. Wow! And now I can send you my programs automatically. I got yours and they worked right off.

Those icons, - you know, like the Apple Lisa - are a lot of fun. I also like the menus, function keys, highlights, help tables - great for a newcomer like me. And with the many options there isn't a computer I can't talk to.

What's really neat is that Softlaw has a whole VIP Library of interactive programs, including a word processor, spreadsheet and database, which will be out soon. Sis promised me the whole set for my birthday.

I see by the built-in "old clock" on the screen that long-distance rates are down. Got to call that L.A. B B S. Yep, there goes the alarm. Later.

- Lore

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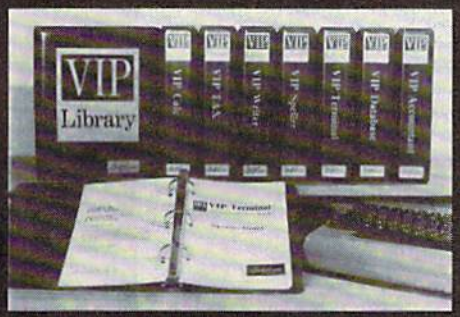

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variables used to keep track of key SID registers; it then initializes the two SID voices used in the program. Voices 1 and 2 emulate the VIC music and noise voices. Voice 3 is initialized, but not used by the program.

For most programs, you can use fixed values for attack/decay (AD), sustain/release (SR), and low frequency (LF). I pick standard Pokes, and change them only if the sound is poor. Finally, the subroutine establishes the starting angle and powder values for each player.

Line 5: The C-64 Pokes accomplish the same functions as the VIC Pokes; they set the screen border, background and cursor to the desired colors. On the VIC, as discussed above, the value stored at location 36879 controls the border and background colors.

The colors resulting from these Pokes on the VIC are white, white and blue for the border, background and cursor. The C-64 colors are white, white and gray 1.

On the C-64 version, KX is set to 54272. This is the offset between the character and color screen memory locations. It is used later in the program and is required to maintain the program structure.

At times, editing statements from the VIC (maximum length of 88 characters) to fit the C-64 (maximum length of 80 characters) requires keyword abbreviations and extra variables or statements.

Line 7: This enhancement subroutine (lines 4000–4100) writes the game instructions to the screen. It returns to statement 7 when the Peek or value stored at location 197 (key being depressed) is set to 60. This occurs when you press the space bar.

Line 11: Enhancements are made to the C-64 version to set the current values of angle (A) and powder (V) to the values previously selected by player 1 or 2. The current parameters are saved in statement 27 and initialized in statement 3630.

Line 13: The extra Poke in the C-64 program is required to restore the cursor color to gray 1 after the mountains and cannons were printed to the screen in subroutine 3200.

Lines 14, 15, 18, 19 and 24: The changes to these lines are required because of the differences in the keyboards. A Peek of location 197 or 203 returns different values on the two computers when the same key is pressed. Table 2 compares these values.

Line 24: In the C-64 version, the equivalent VIC sound Poke is eliminated. The VIC Poke turns the volume to its highest level, 15. If this Poke were not eliminated, a popping sound would be heard from the SID. The conversion of the selected firing angle to radians is delayed until it is saved as AS(PL) in statement 27.

Lines 25, 36, 65, 67, 81, 120, 2001, 2003, 2060, 2070, 2076 and 2078: The VIC sound Pokes in these statements were changed to produce comparable noise or music. To keep the conversion procedure simple, I decided to set most of the SID registers in subroutine 3500; however, a minimum of three must be controlled. This is one more register than required on the VIC.

The C-64 registers are VL (volume), HF (high frequency) and WF (waveform). The VIC registers are volume (36878) and frequency, or voice, (36874–36877). The volume registers of the two computers are handled identically, but the frequency registers have a different Poking range. The VIC registers can be Poked with values between 128 and 255, whereas the C-64 range, 0 to 255, is twice as large.

The C-64 waveform registers are used to select the type of sound produced and to turn it on and off. I set up voice 1 for noise and voice 2 for music. The voice 1 waveform, WF(1), contains either 129 (noise-on) or 128 (noise-off). Similarly, the voice 2 waveform register contains either 17 (music-on) or 16 (music-off).

The VIC frequency registers control the type of sound produced. The first three registers (lowest register is lowest octave voice) emit musical sounds and the last register emits noise.

Sound On—Sound Off

The procedure to produce sound on the C-64 is:

- Poke the volume register to the VIC level.
- Subtract 127 from the VIC frequency register level and double the result.
- Poke the high frequency register to the value from the last step.
- Poke the waveform register to either 17 or 129 to turn on the proper sound.

A simple Poke of the waveform, 16 or 128, turns off the C-64 sound. The VIC turns sound on by Poking the volume and frequency registers.

VIC Address	Function	C-64 Address
197 or 203	Current key depressed	197 or 203
646	Color of cursor	646
7680–8185	Screen character memory location (see Listing 1 for conversion)	1024–2023
36874–36878	Sound registers	54272–54296
36879	Screen color register (background and border)	53280 and 53281
37137	Alternate joystick output register	---
37139	Alternate joystick data direction register	---
37151	Primary joystick output register for switches 0, 1 and 2	56320 and 56321 (all switches)
37152	Primary joystick output register for switch 3 (right)	---
37154	Primary joystick data direction register	---
38400–38905	Screen character color memory locations	55296–56295

Table 3. Important VIC-20 addresses and their C-64 counterparts.

The sound is turned off by setting the frequency to a value less than 128.

The duration of the sound on the C-64 depends in part upon whether the extra C-64 waveform Poke is inside the sound loop. The step size of a loop also may require changes, because of the differences in the frequency Poking range. Line 65 of the C-64 program is an example of this type of change.

Line 27: I added this statement to the C-64 version to store the selected angle and powder in the current player's array. The program then converts the angle to radians (see line 24 comments).

(For the many readers who never knew or have forgotten, angles may be measured in radians instead of in degrees. A radian is the measure of an angle—with its vertex at the center of a circle—whose sides intercept an arc of the circle that is equal in length to the circle's radius. Thus the full circumference of a circle—360 degrees—is 2π radians.)

Lines 28 through 35: These statements are added to display the current angle and powder and wind speed for both players on the extra field of the C-64 screen. If these parameters were not printed, the right side of the C-64 screen would be blank. Decisions regarding this section of the screen must be made for every conversion.

Sometimes the area should be used to display score, playing instructions or other information that, in the VIC version, might have to be kept by the players on scraps of paper. At other times, the size of the playing field should be increased. If possible, it is best to use this area, since otherwise the screen will look incomplete.

Lines 37 and 38: These changes are required to increase the size of the blank field used to clear the longer line length of the C-64. When the cannon fires, these statements clear the score and variables selected.

Lines 110, 2060, 3003, 3007, 3010, 3030, 3035, 3070–3075, 3140–3145, 3260, 3261, 3270, and 3271: In these lines the C-64 offset between the character and color memory locations is substituted for the VIC offset (30720). The C-64 offset (54272) is stored as variable KX in statement 5.

Line 115: This statement checks that a valid Poke will be executed in statement 120. The changes are required because of the different sound frequency Poking ranges of the two machines.

Lines 1000 and 1110: The number of columns on the C-64 display (40) is substituted for the VIC column count (22) in both Peek statements.

Lines 2070 and 2075: The screen Pokes for the C-64 version are changed to reflect the larger number of columns. The VIC 22 becomes a 40. Similarly, the VIC 43 becomes a 79, which is one less than twice the number of screen columns. Finally, the VIC 45 becomes an 81, which is one *more* than twice the number of columns.

Summary

This exercise demonstrates that converting a VIC program to run on the C-64 is not a hard task. Because both machines share the same Basic language (Commodore 2.0), all logic statements and mathematical expressions are completely transferable. The programs need to be changed primarily where Peeks and Pokes are involved. Table 3 lists some important addresses that are normally encountered in VIC listings, with the corresponding addresses for the C-64.

If you encounter these addresses while converting, change the address as discussed above, and you should be able to get proper program response. If you encounter difficulties or addresses not discussed, the *Commodore Programmer's Reference Guides* should provide additional information. If problems persist, a local user's group or friends may be able to help you. R

Listing 2. Original Artillery program for the VIC-20. This listing will not run on an unexpanded VIC-20 unless the REM statements are removed.

```
0 CLR:DEFFNCL(R)=7680.5+INT(22.5-Y)*22+X:X=RND(-TI):PL=
    1
1 REM*THIS IS ARTILLERY 20 ORIG. VIC PROGRAM FROM 'PUBL
    IC DOMAIN'*SEE REMARKS**
5 PRINT"[SHFT CLR]":POKE36879,25
9 GOSUB3000:W=(2*RND(1)):W=W/2:R=INT(2*RND(1)+1):IFR=1T
    HENW=-(W)
10 G=9.8:H=.04:T=0:VX=0:VY=0:X=0:Y=0
11 R=INT(2*RND(1)+1):LP=0:A=45:V=20:IFPL=2THENLP=11
12 RR=(RND(1)):R=INT(2*RND(1)+1):IFRR>.2THENRR=.2
13 GOSUB3200
14 IFPEEK(197)=39THENA=A+1
15 IFPEEK(197)=47THENA=A-1
16 IFA<0THENA=0
17 IFA>90THENA=90
18 IFPEEK(197)=55THENV=V+1
19 IFPEEK(197)=63THENV=V-1
20 IFV<1THENV=1
21 IFV>40THENV=40
22 PRINT"[HOME]"SPC(LP+7)"[SPACE][SPACE]":PRINT"[HOME]"
    SPC(LP)"ANGLE="A
23 PRINT"[HOME][CRSR DN]"SPC(LP+8)"[SPACE][SPACE]":PRIN
    T"[HOME][CRSR DN]"SPC(LP)"POWDER="V
24 IFPEEK(197)=15THENA=[PI]/180*A:POKE36878,15:GOTO37
25 POKE36878,WH:POKE36877,WD:GOTO14
37 POKE36877,0:PRINT"[HOME][44 SPACES]"
38 PRINT"[HOME][CRSR DN][CRSR DN][22 SPACES]"
39 ONPLGOTO40,50
40 X=X1:Y=Y1+1:XI=X:YI=Y:PC=FNCL(0):S=1:GOTO60
50 S=-1:X=X2:Y=Y2+1:XI=X:YI=Y:PC=FNCL(0)
60 VY=SIN(A)*V:VX=S*(COS(A)*V):FORI=228TO168STEP-1:POKE
    36877,I:NEXT:POKE36877,0
70 T=T+H:X=XI+VX*T-W*T[UP ARROW]2:Y=YI+VY*T-G*T[UP ARRO
    W]2
75 PK=7680.5+INT(22.5-Y)*22+X:PK=INT(PK):POKEPC,32
80 IFY>22THEN115
81 IFX<0ORX>21THENPOKE36876,0:GOTO2004
85 PC=PK:IFY<0THEN2000
90 IFPEEK(PK)<>32THEN1000
110 POKEPK+30720,0:POKEPK,46
115 IFY*2+137=>255ORY*2+137<0THEN130
120 POKE36876,Y*2+137
130 IFY>0THEN70
140 GOTO2000
1000 IFPEEK(PK)=233ORPEEK(PK-22)=233THENPOKEPK,42:H1=H1
    +1:H=1:PL=1:GOTO2060
```

More

Listing 2 continued.

```
1110 IFPEEK(PK)=223ORPEEK(PK-22)=223THENPOKEPK,42:H2=H2
     +1:H=1:PL=2:GOTO2060
2000 KK=PEEK(PK):POKEPK,32:I=SIN(I):POKEPK,KK:POKEPK,32
     :I=SIN(I):POKEPK,KK
2001 POKE36876,0:FORI=1TO50:POKE36877,128+I:NEXT
2002 POKEPK,32:I=SIN(I):POKEPK,KK:POKEPK,32:I=SIN(I):PO
     KEPK,KK
2003 FORI=1TO50:POKE36877,178-I:NEXT:POKE36877,0
2004 IFPL=1THENPL=2:GOTO2010
2005 IFPL=2THENPL=1:GOTO2010
2010 IFH=1THENH=0:PRINT"[SHFT CLR]":GOTO9
2020 GOTO10
2060 K=30720:POKE36876,0:G=7:SO=36877:FORI=1TO10
2070 POKEPK+K,G:POKESO,128:S=SIN(I):POKEPK-22+K,G
2072 POKEPK-43+K,G:POKESO,158:POKEPK-45+K,G
2076 POKESO,188:S=SIN(I):S=SIN(I):IFG=42THENG=32:GOTO20
     78
2077 G=42:K=0
2078 NEXTI:POKESO,128:FORI=1TO100:NEXT:POKESO,0:GOTO200
     4
2087 G=42:K=0
3000 PRINT"[HOME][CRSR DN][CRSR DN][CTRL 9][CTRL 3]SC="
     H1"[HOME][CRSR DN][CRSR DN][11 CRSR RTS][CTRL 5]SC
     ="H2
3003 R=INT(6*RND(1)+1):FORY=0TOR-1:FORX=0TO5:POKEFNCL(0
     )+30720,5
3005 POKEFNCL(0),224:NEXTX:NEXTY
3007 Y1=Y:X1=INT(4*RND(1)+1):X=X1:POKEFNCL(0)+30720,2:P
     OKEFNCL(0),223
3010 FORY=0TO5:FORX=6TO15:POKEFNCL(0)+30720,5
3020 POKEFNCL(0),160:NEXTX:NEXTY:R=INT(6*RND(1)+1):FORY
     =0TOR-1:FORX=16TO21
3030 POKEFNCL(0)+30720,5:POKEFNCL(0),224:NEXTX:NEXTY
3035 Y2=Y:X2=INT(3*RND(1)+17):X=X2:POKEFNCL(0)+30720,4:
     POKEFNCL(0),233
3040 P1=INT(3*RND(1)+1):P1=P1+5:P2=INT(3*RND(1)+1):P2=1
     6-P2:I=INT(2*RND(1)+1)
3050 IFI=1THENL1=225:GOTO3060
3055 L1=254
3060 I=INT(2*RND(1)+1):IFI=1THENL2=97:GOTO3070
3065 L2=252
3070 X=P1:Y=6:POKEFNCL(0)+30720,5:POKEFNCL(0),L1
3071 FORX=P1+1TOP2-1:Y=6:POKEFNCL(0)+30720,5
3075 POKEFNCL(0),160:NEXTX:X=P2:POKEFNCL(0)+30720,5:POK
     EFNCL(0),L2
3080 FORY=7TO17:RR=INT(6*RND(1)+1)
3085 IFRR=1THENA1=P1+2:L1=254
3090 IFRR=2THENA1=P1+1:L1=254
3095 IFRR>2THENA1=P1:L1=225
3100 RR=INT(6*RND(1)+1):IFRR=1THENA2=P2-2:L2=252
3110 IFRR=2THENA2=P2-1:L2=252
3120 IFRR>2THENA2=P2:L2=97
3130 IFA2<A1ORA1=A2THEN3160
3140 X=A1:POKEFNCL(0)+30720,5:POKEFNCL(0),L1
3145 POKEFNCL(0),160:NEXTX:X=A2:POKEFNCL(0)+30720,5:POK
     EFNCL(0),L2
3150 P1=A1:P2=A2:IFTT=1THEN3160
3155 NEXTY
3160 PX=P1:PY=Y:RETURN
3200 IFR=1THENRR=-(RR)
3210 W=W+(RR/INT(6*RND(1)+4))
3220 IFW<-2THENW=-2
3225 IFW>2THENW=2
3235 WD=240:WH=INT(ABS(W*8)):IFWH>15THENWH=15
3240 IFW>0THEN3270
3260 X=PX:Y=PY:POKEFNCL(0)+30720,6:POKEFNCL(0),103:Y=Y+
     1
3261 POKEFNCL(0)+30720,6:POKEFNCL(0),103
3262 POKEFNCL(0)+30721,6:POKEFNCL(0)+1,102:GOTO3300
3270 X=PX:Y=PY:POKEFNCL(0)+30720,6:POKEFNCL(0),103:Y=Y+
     1
3271 POKEFNCL(0)+30720,6:POKEFNCL(0),102
3272 POKEFNCL(0)+30721,6:POKEFNCL(0)+1,32
3300 PRINT"[HOME][22 CRSR DNS]"SPC(5)"[CTRL 9][CTRL 6][
     12 SPACES]";
3301 PRINT"[HOME][CRSR DN][CRSR DN][CTRL 9][CTRL 3]SC="
     H1"[HOME][CRSR DN][CRSR DN][11 CRSR RTS][CTRL 5]SC
     ="H2
3302 PRINT"[HOME][22 CRSR DNS]"SPC(5)"[CTRL 9][CTRL 6]W
     IND"INT(ABS(W*80))"MPH[CTRL 1]";:RETURN
```

Listing 3. Artillery program converted for the C-64.

```
0 CLR:DEFFNCL(R)=1024.5+INT(24.5-Y)*40+X:X=RND(-TI):PL=
    1
1 REM**THIS IS ARTILLERY 64 CONVERTED TO C64 FROM 'PUBL
    IC DOMAIN'*SEE REMARKS**
4 GOSUB3500:REM*STARTUP ROUTINE
5 PRINT"[SHFT CLR]":POKEBO,1:POKEBA,1:POKECU,11:KX=5427
    2
7 GOSUB4000:REM*INSTRUCTIONS
9 GOSUB3000:W=(2*RND(1)):W=W/2:R=INT(2*RND(1)+1):IFR=1T
    HENW=-(W):REM*SETUP MT
10 G=9.8:H=.04:T=0:VX=0:VY=0:X=0:Y=0
11 R=INT(2*RND(1)+1):LP=0:A=AS(1):V=VS(1):IFPL=2THENLP=
    11:A=AS(2):V=VS(2)
12 RR=(RND(1)):R=INT(2*RND(1)+1):IFRR>.2THENRR=.2
13 GOSUB3200:POKECU,11:REM*GET WIND AND DISPLAY
14 IFPEEK(197)=4THENA=A+1
15 IFPEEK(197)=5THENA=A-1
16 IFA<0THENA=0
17 IFA>90THENA=90
```

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Listing 3 continued.

```
 18 IFPEEK(197)=6THENV=V+1
 19 IFPEEK(197)=3THENV=V-1
 20 IFV<1THENV=1
 21 IFV>40THENV=40
 22 PRINT"[HOME]"SPC(LP+7)"  ":PRINT"[HOME]"SPC(LP)"ANGL
    E ="A
 23 PRINT"[HOME][CRSR DN]"SPC(LP+8)"  ":PRINT"[HOME][CRS
    R DN]"SPC(LP)"POWDER="V
 24 IFPEEK(197)=1GOTO27
 25 POKEVL,WH:POKEWF(1),129:POKEHF(1),(WD-127)*2:GOTO14:
    REM*WIND SOUND 'ON'
 27 AS(PL)=A:VS(PL)=V:A=[PI]/180*A:REM*DISPLAY SELECTION
    S
 28 PRINT"[HOME][3 CRSR DNS]"SPC(27)"PLAYER # 1"
 29 PRINT"[HOME][5 CRSR DNS]"SPC(27)"ANGLE ="AS(1)
 30 PRINT"[HOME][6 CRSR DNS]"SPC(27)"POWDER="VS(1)
 31 PRINT"[HOME][9 CRSR DNS]"SPC(27)"PLAYER # 2"
 32 PRINT"[HOME][11 CRSR DNS]"SPC(27)"ANGLE ="AS(2)
 33 PRINT"[HOME][12 CRSR DNS]"SPC(27)"POWDER="VS(2):WP=I
    NT(W*80):IFWP<0THENWP=WP+1
 34 PRINT"[HOME][15 CRSR DNS]"SPC(27)"WIND  =[7 SPACES]"

 35 PRINT"[HOME][15 CRSR DNS]"SPC(27)"WIND  ="WP
 36 POKEWF(1),128:REM*WIND SOUND 'OFF'
 37 PRINT"[HOME][68 SPACES]"
 38 PRINT"[HOME][CRSR DN][CRSR DN][66 SPACES]"
 39 ONPLGOTO40,50
 40 X=X1:Y=Y1+1:XI=X:YI=Y:PC=FNCL(0):S=1:GOTO60
 50 S=-1:X=X2:Y=Y2+1:XI=X:YI=Y:PC=FNCL(0)
 60 VY=SIN(A)*V:VX=S*(COS(A)*V):REM*CANNON SOUND 'ON'
 65 POKEVL,15:POKEWF(1),129:FORI=(228-127)*2TO(168-127)*
    2STEP-2:POKEHF(1),I:NEXT
 67 POKEWF(1),128:REM*CANNON SOUND 'OFF'
 70 T=T+H:X=XI+VX*T-W*T[UP ARROW]2:Y=YI+VY*T-G*T[UP ARRO
    W]2:REM*PROJECTILE MOVING ROUTINE 70-130
 75 PK=1024.5+INT(24.5-Y)*40+X:PK=INT(PK):POKEPC,32
 80 IFY>22THEN115:REM*PROJECTILE ABOVE SCREEN SOUND ONLY

 81 IFX<00RX>21THENPOKEWF(2),16:GOTO2004:REM*OUT OF BOUN
    DS IN 'X' SOUND 'OFF'
 85 PC=PK:IFY<0THEN2000
 90 IFPEEK(PK)<>32THEN1000
110 POKEPK+KX,0:POKEPK,46
115 IF(Y*2+137-127)*2>255OR(Y*2+137-127)*2<0THEN130:REM
    *SOUND POKE CHECK
120 POKEHF(2),(Y*2+137-127)*2:POKEWF(2),17:REM*PROJECTI
    LE SOUND 'ON'
130 IFY>0THEN70
140 GOTO2000
1000 IFPEEK(PK)=233ORPEEK(PK-40)=233THENPOKEPK,42:H1=H1
    +1:H=1:PL=1:GOTO2060
1110 IFPEEK(PK)=223ORPEEK(PK-40)=223THENPOKEPK,42:H2=H2
    +1:H=1:PL=2:GOTO2060
2000 KK=PEEK(PK):POKEPK,32:I=SIN(I):POKEPK,KK:POKEPK,32
    :I=SIN(I):POKEPK,KK
2001 POKEWF(2),16:POKEWF(1),129:FORI=1TO50:POKEHF(1),I*
    2:NEXT:REM*MT/FLAG 'HIT'
2002 POKEPK,32:I=SIN(I):POKEPK,KK:POKEPK,32:I=SIN(I):PO
    KEPK,KK
2003 FORI=1TO50:POKEHF(1),(178-127-I)*2:NEXT:POKEWF(1),
    128
2004 IFPL=1THENPL=2:GOTO2010
2005 IFPL=2THENPL=1:GOTO2010
2010 IFH=1THENH=0:PRINT"[SHFT CLR]":GOTO9
2020 GOTO10
2060 K=KX:POKEWF(2),16:G=7:SO=HF(1):POKEWF(1),129:FORI=
    1TO10:REM*CANNON 'HIT'
2070 POKEPK+K,G:POKESO,1:S=SIN(I):POKEPK-40+K,G:POKEPK-
    79+K,G:POKESO,61
2075 POKEPK-81+K,G
2076 POKESO,121:S=SIN(I):S=SIN(I):IFG=42THENG=32:GOTO20
    78
2077 G=42:K=0
2078 NEXTI:POKESO,1:FORI=1TO100:NEXT:POKEWF(1),128:GOTO
    2004:REM*SOUND 'OFF'
2087 G=42:K=0
3000 PRINT"[HOME][CRSR DN][CRSR DN][CTRL 9][CTRL 3]SC="
    H1"[HOME][CRSR DN][CRSR DN][11 CRSR RTS][CTRL 5]SC
    ="H2:REM*SETUP MOUNTAIN
3003 R=INT(6*RND(1)+1):FORY=0TOR-1:FORX=0TO5:POKEFNCL(0
    )+KX,5
3005 POKEFNCL(0),224:NEXTX:NEXTY
3007 Y1=Y:X1=INT(4*RND(1)+1):X=X1:POKEFNCL(0)+KX,2:POKE
    FNCL(0),223
3010 FORY=0TO5:FORX=6TO15:POKEFNCL(0)+KX,5
3020 POKEFNCL(0),160:NEXTX:NEXTY:R=INT(6*RND(1)+1):FORY
    =0TOR-1:FORX=16TO21
3030 POKEFNCL(0)+KX,5:POKEFNCL(0),224:NEXTX:NEXTY
3035 Y2=Y:X2=INT(3*RND(1)+17):X=X2:POKEFNCL(0)+KX,4:POK
    EFNCL(0),233
3040 P1=INT(3*RND(1)+1):P1=P1+5:P2=INT(3*RND(1)+1):P2=1
    6-P2:I=INT(2*RND(1)+1)
3050 IFI=1THENL1=225:GOTO3060
3055 L1=254
3060 I=INT(2*RND(1)+1):IFI=1THENL2=97:GOTO3070
3065 L2=252
3070 X=P1:Y=6:POKEFNCL(0)+KX,5:POKEFNCL(0),L1:FORX=P1+1
    TOP2-1:Y=6
3072 POKEFNCL(0)+KX,5
3075 POKEFNCL(0),160:NEXTX:X=P2:POKEFNCL(0)+KX,5:POKEFN
```

More →

Listing 3 continued.

```
    CL(0),L2
3080 FORY=7TO17:RR=INT(6*RND(1)+1)
3085 IFRR=1THENA1=P1+2:L1=254
3090 IFRR=2THENA1=P1+1:L1=254
3095 IFRR>2THENA1=P1:L1=225
3100 RR=INT(6*RND(1)+1):IFRR=1THENA2=P2-2:L2=252
3110 IFRR=2THENA2=P2-1:L2=252
3120 IFRR>2THENA2=P2:L2=97
3130 IFA2<A1ORA1=A2THEN3160
3140 X=A1:POKEFNCL(0)+KX,5:POKEFNCL(0),L1:FORX=A1+1TOA2
     -1:POKEFNCL(0)+KX,5
3145 POKEFNCL(0),160:NEXTX:X=A2:POKEFNCL(0)+KX,5:POKEFN
     CL(0),L2
3150 P1=A1:P2=A2:IFTT=1THEN3160
3155 NEXTY
3160 PX=P1:PY=Y:RETURN
3200 IFR=1THENRR=-(RR):REM*GET WIND AND DISPLAY
3210 W=W+(RR/INT(6*RND(1)+4))
3220 IFW<-2THENW=-2
3225 IFW>2THENW=2
3235 WD=240:WH=INT(ABS(W*8)):IFWH>15THENWH=15
3240 IFW>0THEN3270
3260 X=PX:Y=PY:POKEFNCL(0)+KX,6:POKEFNCL(0),103:Y=Y+1:P
     OKEFNCL(0)+KX,6
3261 POKEFNCL(0),103:POKEFNCL(0)+KX+1,6:POKEFNCL(0)+1,1
     02:GOTO3300
3270 X=PX:Y=PY:POKEFNCL(0)+KX,6:POKEFNCL(0),103:Y=Y+1:P
     OKEFNCL(0)+KX,6
3271 POKEFNCL(0),102:POKEFNCL(0)+KX+1,6:POKEFNCL(0)+1,3
     2
3300 PRINT"[HOME][22 CRSR DNS]"SPC(5)"[CTRL 9][CTRL 6][
     12 SPACES]";
3301 PRINT"[HOME][CRSR DN][CRSR DN][CTRL 9][CTRL 3]SC="
     H1"[HOME][CRSR DN][CRSR DN][11 CRSR RTS][CTRL 5]SC
     ="H2
3302 PRINT"[HOME][22 CRSR DNS]"SPC(5)"[CTRL 9][CTRL 6]W
     IND"INT(ABS(W*80))"MPH[CTRL 1]";:RETURN
3500 REM*STARTUP SID,BORDER,BACKGROUND AND CURSOR REGIS
     TERS ******************
3510 LC=54272:VL=LC+24:BO=53280:BA=BO+1:CU=646
3520 FORMC=LCTOVL:POKEMC,0:NEXT
3530 LF(1)=LC:HF(1)=LC+1:WF(1)=LC+4
3540 AD(1)=LC+5:SR(1)=LC+6
3550 FORI=2TO3:LF(I)=LF(I-1)+7
3560 HF(I)=HF(I-1)+7:WF(I)=WF(I-1)+7
3570 AD(I)=AD(I-1)+7:SR(I)=SR(I-1)+7:NEXTI
3600 REM*SETUP SOUNDS:VOICE1=NOISE:VOICE2=PROJECTILE **
     **********************
3610 POKEAD(1),15:POKESR(1),133:POKELF(1),200
3620 POKEAD(2),7 :POKESR(2),133:POKELF(2),128
3630 AS(1)=45:VS(1)=20:AS(2)=45:VS(2)=20:REM*SETUP STAR
     TING ANGLE AND POWDER
3640 RETURN
4000 PRINT"[SHFT CLR][CRSR DN][14 SPACES]ARTILLERY 64[C
     RSR DN][CRSR DN]":REM*PLAYING INSTRUCTIONS
4010 PRINT"[8 SPACES]KEY[13 SPACES]FUNCTION[CRSR DN]"
4020 PRINT"[8 SPACES]F1[11 SPACES]INCREASE ANGLE[CRSR D
     N]"
4030 PRINT"[8 SPACES]F3[11 SPACES]DECREASE ANGLE[CRSR D
     N]"
4040 PRINT"[8 SPACES]F5[11 SPACES]INCREASE POWDER[CRSR
     DN]"
4050 PRINT"[8 SPACES]F7[11 SPACES]DECREASE POWDER[CRSR
     DN]"
4060 PRINT"[6 SPACES]RETURN[9 SPACES]SHOOT PROJECTILE[4
      CRSR DNS]"
4070 PRINT"[8 SPACES]PRESS [CTRL 9]SPACE BAR[CTRL 0] TO
      START"
4080 IFPEEK(197)<>60THEN4080
4090 PRINT"[SHFT CLR]"
4100 RETURN
```


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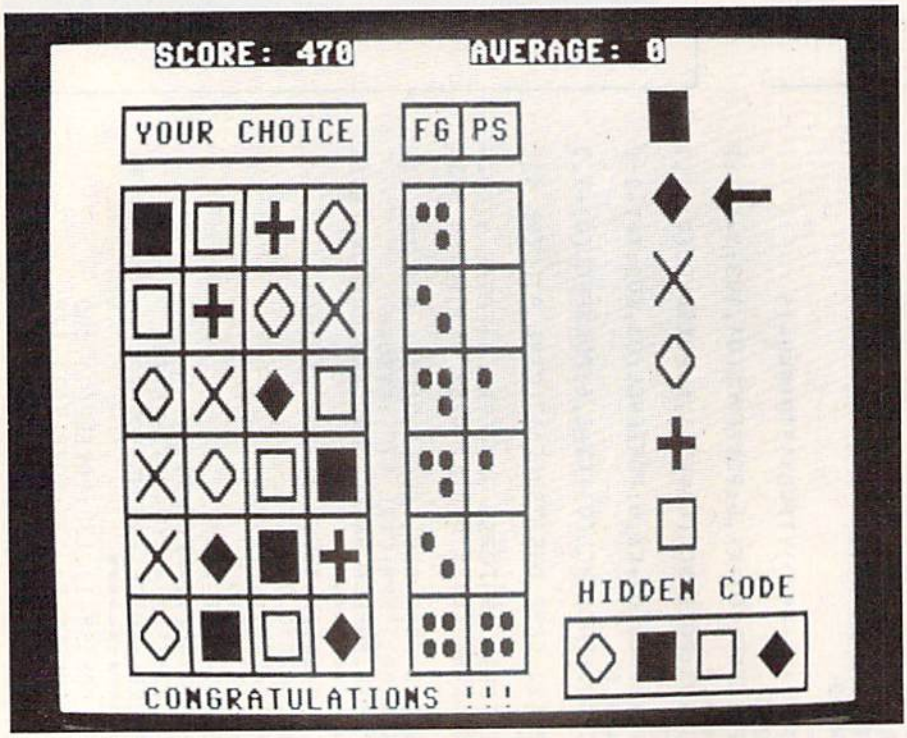
Can You Solve The Riddle Of the Symbol Code?

This game is a mind challenger. Fast thinking is a plus, but fast reaction, manual dexterity, and everything else that makes you a good arcade-game player, are irrelevant.

By Evangelos Petroutsos

Symbol Code is an adaptation for the Commodore 64 computer of the once very popular table-game, Mastermind. The object of Mastermind is to break a code consisting of a sequence of four colors selected from a palette of six different colors. The code is set by another player. Each time you make a guess, you are provided with some information concerning the success of your attempt. Good judgment and the use of all available information will help you break the hidden code.



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Commodore 64

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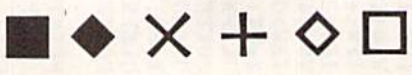

Fig. 1. The symbols used to form the codes in the game program, Symbol Code.

Many Permutations

Symbol Code uses six different symbols (Fig. 1) instead of colors, so that the display is more interesting and the game can be played on either a color or a black and white TV set. Since the code consists of four out of six symbols, there are at least 360 possible four-symbol codes. If we allow any symbol to appear more than once in the code, there can be as many as 6^4, or 1296, possible codes. The challenge is to break the hidden code in as few trials as possible. Your task is not easy, as you will discover!

Let's take a look at the game. After you run the program, an empty grid will appear on the screen. Its columns are labeled 1, 2, 3, 4, FG and PS. The six symbols are displayed at the right-hand side of the screen, with an arrow pointing to the first one. Your guesses will appear in the first four columns.

The columns labeled PS and FG will be filled in by the computer as follows: FG is the number of symbols you have guessed correctly. PS shows the number of correctly guessed symbols which are also in the correct position.

For example, three dots in the FG column and one dot in the PS column indicate that in your last guess you have guessed three symbols correctly, but only one of them is in the correct position. Your task is to find out which are the correctly guessed symbols and which one is in the correct position.

The grid is large enough to display six consecutive efforts. If you have not broken the code after the six trials, your next guess will replace the least recent one. After you become familiar with the game, however, you will realize that you don't really need more than six

guesses to break the code.

Making the Moves

To enter your move, first, choose a symbol and the position in which you want it placed. Then, using the function keys, move the arrow up (F1) or down (F7) so that it points to the desired symbol. Lastly, hit the key (1, 2, 3 or 4) corresponding to the square in which you wish to place the selected symbol, and it will appear there.

In case you change your mind, you can overwrite any symbol in any position, changing the combination as many times as you wish before hitting the space-bar to enter your move. But once all four squares are filled and you hit the space-bar, there is no turning back. When you hit the space-bar, the program will read your move, compare it to the hidden code and display the results of the comparison in the FG and PS columns next to your guess.

Although the hidden code ordinarily consists of four *different* symbols, you may choose to repeat a symbol in any given guess to try to find out whether or not it belongs to the hidden code. Beginners frequently use this technique, which sometimes—combined with a little luck—provides useful information about the hidden code at the first stages of the game.

After a few games, you'll be cracking the hidden code with the prowess of a Sherlock Holmes.

Suppose, for example, that the hidden code does *not* include the symbol "x" or "+," and that your first guess is "+ + x x." The results of the comparison tell you immediately the four symbols making up the code. Then you have to determine their order. After breaking the hidden code, you can start a new game by pressing any function key.

One last feature of the game is the Help command. As you try to break the hidden code, four small black squares are continuously displayed at the lower right-hand corner of the screen. These are the symbols in the hidden code. Each time you press H, one of the symbols in the hidden code will be revealed. When you break the code, all four symbols will be displayed there.

A word about the score. The maximum score you can get in one play is 500. If you break the code with your first or second guess, you get all 500 points. If not, each unsuccessful guess after the first two will cost you ten points. You also lose 50 points every time you ask for Help, and asking for Help four times in the same play reduces your score to zero. Your current score, as well as the average score of all your previous games, will be displayed at the top of the screen.

Listing 1 shows you the game program, along with some useful remarks. Lines 135 and 137 compare the symbols in the hidden code to make sure no symbol appears twice. If you find the game too easy to play, you can remove these two lines. Doing so will almost triple the number of possible combinations for the hidden code.

A word of caution: This program plays around with the display list, and you should be very careful when typing it into your computer. Any typos in the Poke statements might cause the computer to crash. Be sure you Save the program before you try to run it, so that even if something goes wrong, you'll not have to type it in again. R

Listing 1. Symbol Code program.

```
 79 REM ************************
 80 REM ***     SYMBOL CODE     ***
 81 REM ***                     ***
 82 REM ***                     ***
 83 REM *** EVANG. PETROUTSOS ***
 84 REM ************************
 85 REM
 90 REM ** "[CRSR DN]" CURSOR DOWN
 91 REM ** "[CRSR RT]" CURSOR RIGHT
 92 REM ** "[HOME]" CURSOR HOME
 93 REM ** "[SHFT CLR]" CLEAR SCREEN
 94 REM ** "[CTRL 1]" CONTROL-BLACK
 95 REM
100 L=1137:PRINT"[CTRL 1]":POKE53281,13
105 DD=1268:EF=0:RV=0:SC=500
110 RESTORE:FORI=1TO6:FORJ=1TO4:READA%(I,J):NEXT:NEXT
120 EF=0:FORM=1 TO 4
125 D(M)=INT(RND(3)*6)+1:IFD(M)>6THEN125
130 IFM=1THEN140
135 FORI=1TOM-1:IFD(M)=D(M-I)THEN125
137 NEXT
140 NEXT
190 REM ** THE SUBROUTINES AT LINES:
191 REM ** 1000, 1200, 1300
192 REM ** DRAW THE GRID AND THE SYMBOLS
193 REM ** ON THE SCREEN
200 GOSUB1000:GOSUB1300:GOSUB1200
202 GOSUB400
205 PRINT"[HOME][CRSR RT][CRSR RT][CRSR RT][CRSR RT][CR
    SR RT][CTRL 9]SCORE:";SC;"[CTRL 0]";"[CRSR RT][CRS
    R RT][CRSR RT][CRSR RT][CRSR RT][CTRL 9]AVERAGE:";
    V9;"[CTRL 0]"
208 GETR$:IFR$=""THEN208
210 IFR$="[FUNCT 1]"THEN235:REM F1 FUNCTION KEY
212 IFR$="[FUNCT 7]"THEN240:REM F7 FUNCTION KEY
213 IFR$=" "THEN600
214 IFR$="1"THENSD=DD:A1=1:GOTO500
215 IFR$="2"THENSD=DD+3:A2=1:GOTO500
216 IFR$="3"THENSD=DD+6:A3=1:GOTO500
217 IFR$="4"THENSD=DD+9:A4=1:GOTO500
220 IFR$="H"THENSC=SC-50:GOTO450
230 GOTO205
235 L1=L:L=L-120:IFL<1137THENL=1737
236 GOTO245
240 L1=L:L=L+120:IFL>1737THENL=1137
245 GOSUB1200
250 GOTO205
400 REM ** HIDDEN CODE **
402 POKE1930,102:POKE1931,102:POKE1933,102:POKE1934,102
    :POKE1936,102
405 POKE1937,102:POKE1939,102:POKE1940,102
```

More

Listing 1 continued.

```
410 POKE1970,102:POKE1971,102:POKE1973,102:POKE1974,102
    :POKE1976,102
415 POKE1977,102:POKE1979,102:POKE1980,102
420 PRINT"[HOME][20 CRSR DOWNS][26 CRSR RIGHTS]HIDDEN C
    ODE";
430 PRINT"[HOME][21 CRSR DOWNS][25 CRSR RIGHTS][COMD A]
    [11 SHFT C'S][COMD S]"
432 PRINT"[25 CRSR RIGHTS][SHFT B][11 CRSR RIGHTS][SHFT
    B]"
434 PRINT"[25 CRSR RIGHTS][SHFT B][11 CRSR RIGHTS][SHFT
    B]"
436 PRINT"[25 CRSR RIGHTS][COMD Z][11 SHFT C'S][COMD X]
    ";:PRINT"[HOME]":RETURN
450 REM *** HELP ***
455 IFRV=0THEN Q1=1930:GOTO460
456 IFRV=1THEN Q1=1933:GOTO460
457 IFRV=2THEN Q1=1936:GOTO460
458 Q1=1939
460 RV=RV+1:F1=D(RV)
465 POKEQ1,A%(F1,1):POKEQ1+1,A%(F1,2):POKEQ1+40,A%(F1,3
    ):POKEQ1+41,A%(F1,4)
467 IFR$="H"ANDRV=4THENSC=0:GOTO822
470 IFRV=4THEN 830
475 IFGG=9THENRETURN
480 GOTO205
500 REM*** DRAW A FIGURE ***
505 IFL=1137THENFG=1:GOTO520
506 IFL=1257THENFG=2:GOTO520
507 IFL=1377THENFG=3:GOTO520
508 IFL=1497THENFG=4:GOTO520
509 IFL=1617THENFG=5:GOTO520
510 IFL=1737THENFG=6:GOTO520
520 POKESD,A%(FG,1):POKESD+1,A%(FG,2):POKESD+40,A%(FG,3
    ):POKESD+41,A%(FG,4)
522 R=VAL(R$):B(R)=FG
525 GOTO205
600 IFA1=00RA2=00RA3=00RA4=0THEN205
605 F=0:P=0
610 A1=0:A2=0:A3=0:A4=0:EF=EF+1
640 FORI1=1TO4:IFB(I1)=D(I1)THENP=P+1
643 NEXT
650 FORM=1 TO 4:FOR K=1TO4:
655 FORS=1TOM-1:IF B(M)=B(M-S)THENS=M-1:K=4:GOTO690
657 NEXTS
680 IFB(M)=D(K)THENF=F+1
685 NEXTK
690 NEXTM
695 IFP<4THENGOSUB1600
696 IFP=4THENDD=DD+120
700 REM *** CHECK GUESS ***
701 IFEF>2THENSC=SC-10
702 DR=DD-120:IF F=0THEN780
703 IFDD=1268THENDR=1868
705 POKEDR+14,81:
710 IF F=1THEN750
712 POKEDR+55,81
715 IFF=2THEN750
717 POKEDR+15,81
718 IFF=3THEN750
720 POKEDR+54,81:
750 IFP=0THEN205
752 POKEDR+17,81:IFP=1THEN205
753 POKEDR+58,81:IFP=2THEN205
755 POKEDR+18,81:IFP=3THEN205
758 POKEDR+57,81
780 IFP<4THEN205
800 REM *** CORRECT GUESS ***
810 PRINT"[HOME][23 CRSR DNS]":PRINT"[CRSR RT][CRSR RT]
    [CRSR RT][CRSR RT]CONGRATULATIONS !!!";
814 GM=GM+1:SC=SC+10:D9=SC-VG:VG=VG+D9/GM:V9=INT(VG)
816 REMPRINT"[HOME]";"[CRSR RT][CRSR RT][CRSR RT][CRSR
    RT][CRSR RT][CTRL 9]SCORE:";SC;"[CTRL 0]";"[CRSR R
    T][CRSR RT][CRSR RT][CRSR RT][CRSR RT][CTRL 9]AVER
    AGE:";V9;"[CTRL 0]"
820 GG=9:RV=0:GOSUB450:RV=1:GOSUB450:RV=2:GOSUB450:RV=3
    :GOSUB450:GG=0
822 SC=0:GM=GM+1:D9=SC-VG:VG=VG+D9/GM:V9=INT(VG)
823 PRINT"[HOME][33 SPACES]";
824 PRINT"[HOME]";"[CRSR RT][CRSR RT][CRSR RT][CRSR RT]
    [CRSR RT][CRTL 9]SCORE:";SC;"[CTRL 0]";"[CRSR RT][
    CRSR RT][CRSR RT][CRSR RT][CRSR RT][CRTL 9]AVERAGE
    :";V9;"[CTRL 0]";"      "
825 SC=500:EF=0
830 GETF$:IFF$<>"[FUNCT 1]"ANDF$<>"[FUNCT 3]"ANDF$<>"[F
    UNCT 5]"ANDF$<>"[FUNCT 7]"THEN830
840 PRINT"[SHFT CLR]":GG=0:F=0:P=0:DD=1268:L=1137:RV=0:
    GOTO100
1000 PRINT"[SHFT CLR][CRSR DN][CRSR DN]"
1002 PRINT"[CRSR RT][CRSR RT][CRSR RT][COMD A][SHFT *][
    SHFT *][SHFT *][SHFT *][SHFT *][SHFT *][SHFT *][SH
    FT *][SHFT *][SHFT *][SHFT *][COMD S][SPACE][COMD
    A][SHFT *][SHFT *][COMD R][SHFT *][SHFT *][COMD S]
1004 PRINT"[CRSR RT][CRSR RT][CRSR RT][SHFT B]YOUR CHOI
    CE[SHFT B][SPACE][SHFT B]FG[SHFT B]PS[SHFT B]"
1006 PRINT"[CRSR RT][CRSR RT][CRSR RT][COMD Z][SHFT *][
    SHFT *][SHFT *][SHFT *][SHFT *][SHFT *][SHFT *][SH
    FT *][SHFT *][SHFT *][SHFT *][COMD X][SPACE][COMD
    Z][SHFT *][SHFT *][COMD E][SHFT *][SHFT *][COMD X]
1010 PRINT"[CRSR RT][CRSR RT][CRSR RT][COMD A][SHFT *][
    SHFT *][COMD R][SHFT *][SHFT *][COMD R][SHFT *][SH
    FT *][COMD R][SHFT *][SHFT *][COMD S][SPACE][COMD
    A][SHFT *][SHFT *][COMD R][SHFT *][SHFT *][COMD S]
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Listing 1 continued.

```
1012 PRINT"[CRSR RT][CRSR RT][SHFT -][SPACE][S
     PACE][SHFT -][SPACE][SPACE][SHFT -][SPACE][SPACE][
     SHFT -][SPACE][SPACE][SHFT -][SPACE][SHFT -][SPACE
     ][SPACE][SHFT -][SPACE][SPACE][SHFT -]"
1014 PRINT"[CRSR RT][CRSR RT][CRSR RT][SHFT -][SPACE][S
     PACE][SHFT -][SPACE][SPACE][SHFT -][SPACE][SPACE][
     SHFT -][SPACE][SPACE][SHFT -][SPACE][SHFT -][SPACE
     ][SPACE][SHFT -][SPACE][SPACE][SHFT -]"
1016 PRINT"[CRSR RT][CRSR RT][CRSR RT][COMD Q][SHFT *][
     SHFT *][SHFT +][SHFT *][SHFT +][SHFT *][SHFT +][SH
     FT *][SHFT +][SHFT *][SHFT *][COMD W][SPACE][COMD
     Q][SHFT *][SHFT *][SHFT +][SHFT *][SHFT *][COMD W]
1018 PRINT"[CRSR RT][CRSR RT][CRSR RT][SHFT -][SPACE][S
     PACE][SHFT -][SPACE][SPACE][SHFT -][SPACE][SPACE][
     SHFT -][SPACE][SPACE][SHFT -][SPACE][SHFT -][SPACE
     ][SPACE][SHFT -][SPACE][SPACE][SHFT -]"
1020 PRINT"[CRSR RT][CRSR RT][CRSR RT][SHFT -][SPACE][S
     PACE][SHFT -][SPACE][SPACE][SHFT -][SPACE][SPACE][
     SHFT -][SPACE][SPACE][SHFT -][SPACE][SHFT -][SPACE
     ][SPACE][SHFT -][SPACE][SPACE][SHFT -]"
1022 PRINT"[CRSR RT][CRSR RT][CRSR RT][COMD Q][SHFT *][
     SHFT *][SHFT +][SHFT *][SHFT +][SHFT *][SHFT +][SH
     FT *][SHFT +][SHFT *][SHFT *][COMD W][SPACE][COMD
     Q][SHFT *][SHFT *][SHFT +][SHFT *][SHFT *][COMD W]
1024 PRINT"[CRSR RT][CRSR RT][CRSR RT][SHFT -][SPACE][S
     PACE][SHFT -][SPACE][SPACE][SHFT -][SPACE][SPACE][
     SHFT -][SPACE][SPACE][SHFT -][SPACE][SHFT -][SPACE
     ][SPACE][SHFT -][SPACE][SPACE][SHFT -]"
1026 PRINT"[CRSR RT][CRSR RT][CRSR RT][SHFT -][SPACE][S
     PACE][SHFT -][SPACE][SPACE][SHFT -][SPACE][SPACE][
     SHFT -][SPACE][SPACE][SHFT -][SPACE][SHFT -][SPACE
     ][SPACE][SHFT -][SPACE][SPACE][SHFT -]"
1028 PRINT"[CRSR RT][CRSR RT][CRSR RT][COMD Q][SHFT *][
     SHFT *][SHFT +][SHFT *][SHFT +][SHFT *][SHFT +][SH
     FT *][SHFT +][SHFT *][SHFT *][COMD W][SPACE][COMD
     Q][SHFT *][SHFT *][SHFT +][SHFT *][SHFT *][COMD W]
1030 PRINT"[CRSR RT][CRSR RT][CRSR RT][SHFT -][SPACE][S
     PACE][SHFT -][SPACE][SPACE][SHFT -][SPACE][SPACE][
     SHFT -][SPACE][SPACE][SHFT -][SPACE][SHFT -][SPACE
     ][SPACE][SHFT -][SPACE][SPACE][SHFT -]"
1032 PRINT"[CRSR RT][CRSR RT][CRSR RT][SHFT -][SPACE][S
     PACE][SHFT -][SPACE][SPACE][SHFT -][SPACE][SPACE][
     SHFT -][SPACE][SPACE][SHFT -][SPACE][SHFT -][SPACE
     ][SPACE][SHFT -][SPACE][SPACE][SHFT -]"
1034 PRINT"[CRSR RT][CRSR RT][CRSR RT][COMD Q][SHFT *][
     SHFT *][SHFT +][SHFT *][SHFT *][SHFT +][SHFT *][SH
     FT *][SHFT +][SHFT *][SHFT *][COMD W][SPACE][COMD
     Q][SHFT *][SHFT *][SHFT +][SHFT *][SHFT *][COMD W]
1036 PRINT"[CRSR RT][CRSR RT][CRSR RT][SHFT -][SPACE][S
     PACE][SHFT -][SPACE][SPACE][SHFT -][SPACE][SPACE][
     SHFT -][SPACE][SPACE][SHFT -][SPACE][SHFT -][SPACE
     ][SPACE][SHFT -][SPACE][SPACE][SHFT -]"
```

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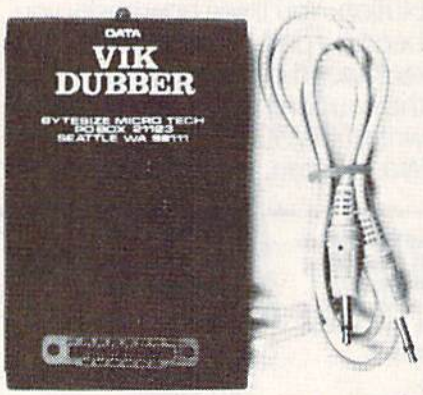

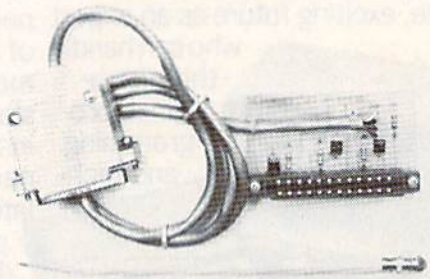

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Listing 1 continued.

```
1038 PRINT"[CRSR RT][CRSR RT][CRSR RT][SHFT -][SPACE][S
     PACE][SHFT -][SPACE][SPACE][SHFT -][SPACE][SPACE][
     SHFT -][SPACE][SPACE][SHFT -][SPACE][SHFT -][SPACE
     ][SPACE][SHFT -][SPACE][SPACE][SHFT -]"
1040 PRINT"[CRSR RT][CRSR RT][CRSR RT][COMD Q][SHFT *][
     SHFT *][SHFT +][SHFT *][SHFT *][SHFT +][SHFT *][SH
     FT *][SHFT +][SHFT *][SHFT *][COMD W][SPACE][COMD
     Q][SHFT *][SHFT *][SHFT +][SHFT *][SHFT *][COMD W]
1042 PRINT"[CRSR RT][CRSR RT][CRSR RT][SHFT -][SPACE][S
     PACE][SHFT -][SPACE][SPACE][SHFT -][SPACE][SPACE][
     SHFT -][SPACE][SPACE][SHFT -][SPACE][SHFT -][SPACE
     ][SPACE][SHFT -][SPACE][SPACE][SHFT -]"
1044 PRINT"[CRSR RT][CRSR RT][CRSR RT][SHFT -][SPACE][S
     PACE][SHFT -][SPACE][SPACE][SHFT -][SPACE][SPACE][
     SHFT -][SPACE][SPACE][SHFT -][SPACE][SHFT -][SPACE
     ][SPACE][SHFT -][SPACE][SPACE][SHFT -]"
1046 PRINT"[CRSR RT][CRSR RT][CRSR RT][COMD Z][SHFT *][
     SHFT *][COMD E][SHFT *][SHFT *][COMD E][SHFT *][SH
     FT *][COMD E][SHFT *][SHFT *][COMD X][SPACE][COMD
     Z][SHFT *][SHFT *][COMD E][SHFT *][SHFT *][COMD X]
1050 RETURN
1200 POKEL1,32:POKEL1+1,32:POKEL1+2,32
1210 POKEL1+40,32:POKEL1+41,32:POKEL1+42,32
1220 POKEL,233:POKEL+1,111:POKEL+2,111
1230 POKEL+40,95:POKEL+41,119:POKEL+42,119:RETURN
1300 POKE1134,160:POKE1135,160:POKE1174,160:POKE1175,16
     0
1310 POKE1254,233:POKE1255,223
1315 POKE1294,95:POKE1295,105
1320 POKE1374,77:POKE1375,78:POKE1414,78
1325 POKE1415,77:POKE1495,77
1335 POKE1494,78:POKE1535,78:POKE1534,77
1340 POKE1614,122:POKE1615,76
1345 POKE1654,80:POKE1655,79
1350 POKE1734,79:POKE1735,80:POKE1774,76:POKE1775,122
1355 RETURN
1600 REM** CLEAR AREA FOR NEXT GUESS **
1615 DD=DD+120:IFSD>1777THENDD=1268
1630 POKEDD,32:POKEDD+1,32:POKEDD+3,32:POKEDD+4,32:POKE
     DD+6,32:POKEDD+7,32
1632 POKEDD+9,32:POKEDD+10,32:POKEDD+14,32:POKEDD+15,32
     :POKEDD+17,32
1634 POKEDD+18,32
1635 POKEDD+40,32:POKEDD+41,32:POKEDD+43,32:POKEDD+44,3
     2:POKEDD+46,32
1636 POKEDD+47,32
1638 POKEDD+49,32:POKEDD+50,32:POKEDD+54,32:POKEDD+55,3
     2:POKEDD+57,32
1639 POKEDD+58,32:RETURN
2000 DATA160,160,160,160,233,223,95,105,77,78,78,77,78,
     77,77,78,122,76,80,79
2010 DATA79,80,76,122
```

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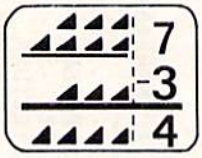

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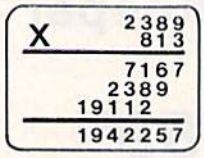

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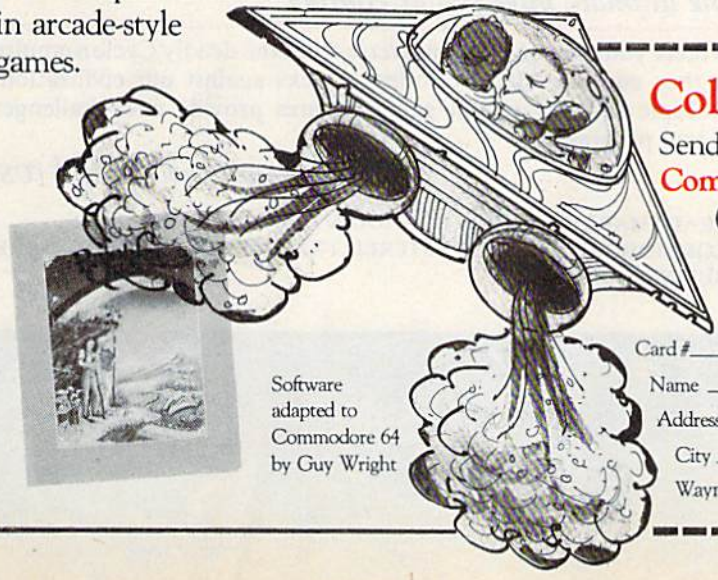

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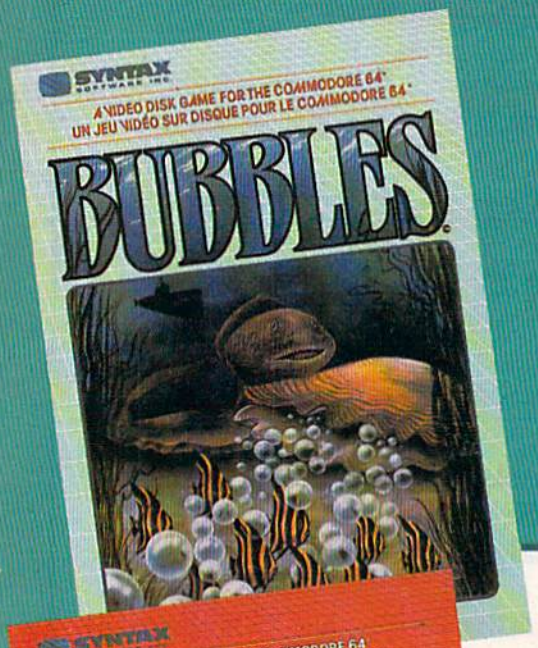

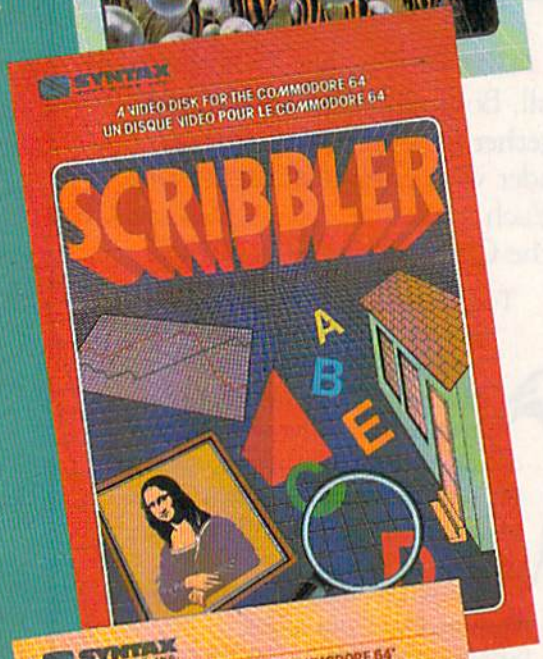

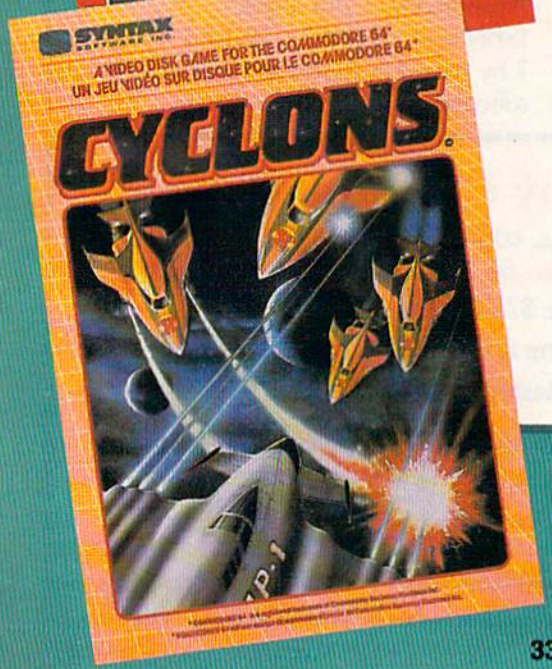

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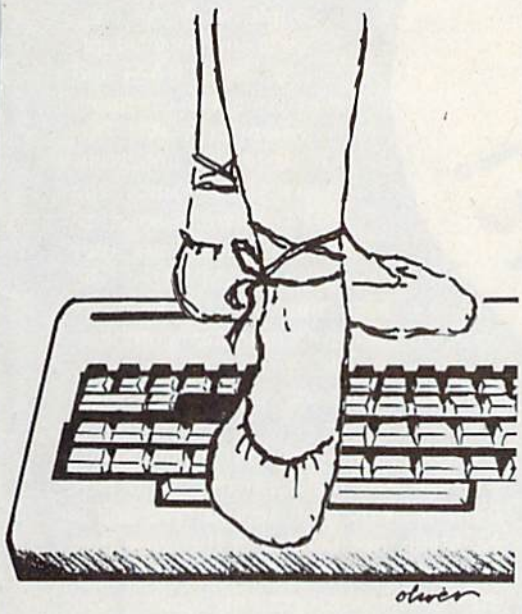
Keep In Step With the Quick VIC

Here are some tricks to help you slow the action of your VIC-20's screen listings so you can read them.

By Robert Spahitz



Address author correspondence to Robert Spahitz, 143 Dewey Ave., Staten Island, NY 10308.

If you do any serious, or even not-so-serious, programming on Commodore's VIC-20 computer, you have probably found it to be occasionally frustrating. Although the VIC's limitations are few, those that exist can almost outweigh the benefits of the machine.

One of the biggest drawbacks is the VIC's screen size. Having only 23 rows of 22 columns, the screen can only hold 506 characters at a time under normal circumstances. A problem stemming from this involves the List command. Since a listing often leaves many screen positions blank, and since most lines in a program require more than one screen line, you don't get very much listed on the screen at any one time.

To compound the problem, the List command displays a program at what seems to be the speed of light! Even if you depress the control key to slow down the speed of the listing, it still goes too fast to copy. The only choice seems to be to list a few lines at a time.

Applying the Brakes

Now here, for the first time anywhere, is a solution to the "swift-list" problem. This trick will not only slow down the listing; it will also slow down anything else the VIC does, so it may give some surprising results.

One nice aspect of this trick is that it has two speeds from which to choose: scan speed (the default), and copy speed (available at the push of a button). This procedure is simple. As soon as you want to slow down the VIC, just enter:

```
POKE 37158,23: POKE 37159,0
```

That's it! Now if you list a program, it goes at scan speed—not too slow and not too fast. This speed is good for scanning, but a bit too fast for copying.

To slow it down to copy speed, just hold down *any* key (except the restore key) or click the shift-lock key. This speed gives you enough time to eat dinner before the screen scrolls to a new set of characters. To return to scan speed, release all keys and make sure the shift-lock key is unclicked.

To return to normal speed, do one of three things: 1) Poke 37159,66; 2) hold the run/stop key and hit the restore key; or 3) type LOAD.

Why It Works

The explanation of this trick is that memory locations 37158 and 37159 are directly related to the VIC's interrupt system, which is what controls the computer's internal clock (the one you can access with TI & TI$). These memory locations tell VIC how often to update this clock.

By lowering the value of memory location 37159, VIC will update the clock more often, and will therefore be able to accomplish less in the same amount of time. With a value of 66, it updates at a normal pace. With a value of zero, it updates much more often, so everything else seems to slow down.

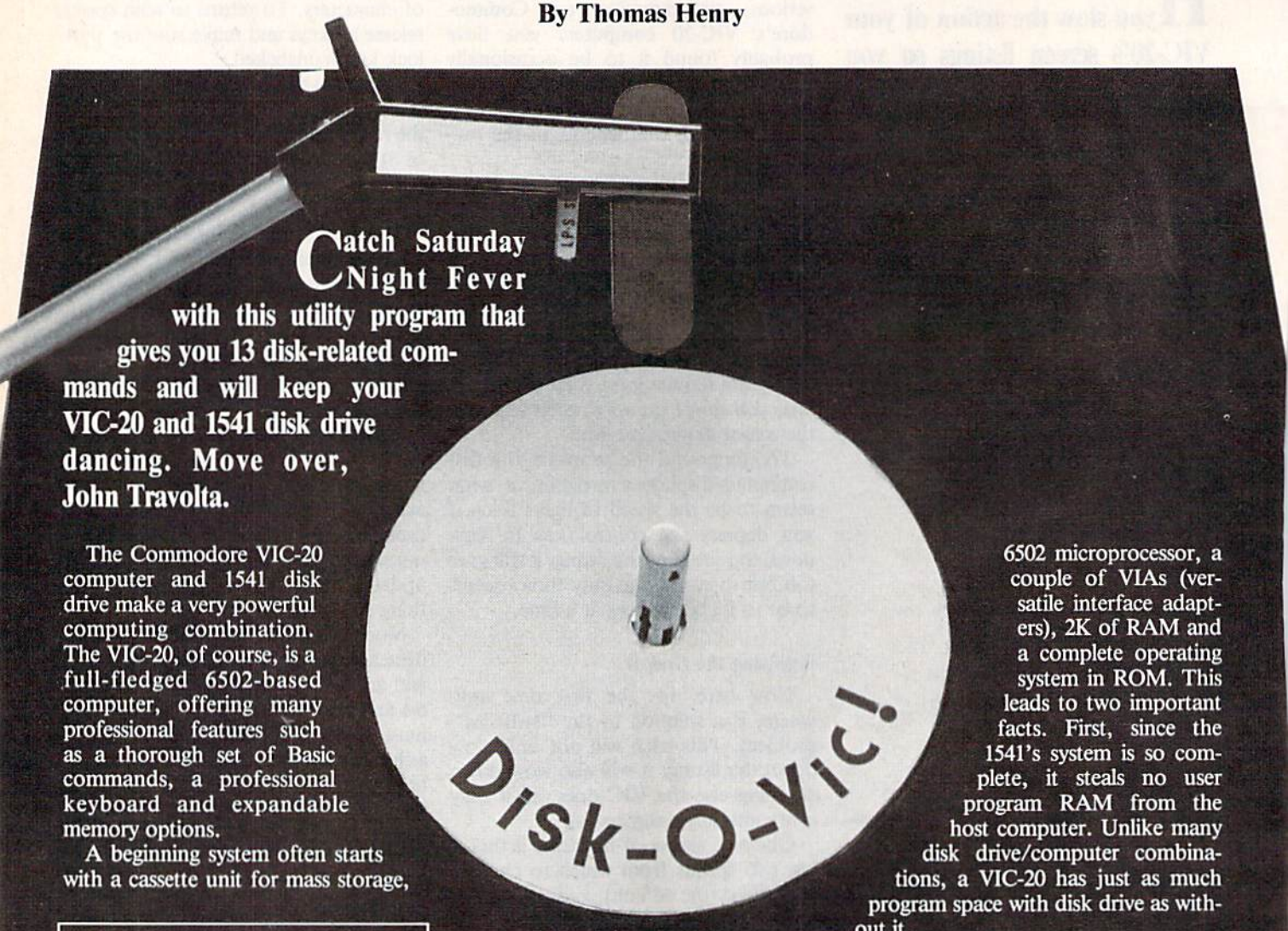
Since the speed must be still further decreased to get human speed (this gives you an idea of just how quick computers and machine language can be), you must do some additional fine-tuning by adjusting memory location 37158. I have found that a value of 23 works best, but another value may suit you better. Just be warned that an increase or decrease in the value stored in 37158 does not necessarily mean a corresponding increase or decrease in the speed of the VIC.

Something else to note is that changing the value of memory location 37159 affects the cursor-repeat speed. I found that a value of 30 gives a nice cursor speed. It also happens that the VIC clock is affected by this, so TI$ will not give accurate time.

Finally, for some fun (and if your patience permits), try running some programs at these slower speeds—the results are often surprising. R

DISK-O-VIC

By Thomas Henry



Catch Saturday Night Fever with this utility program that gives you 13 disk-related commands and will keep your VIC-20 and 1541 disk drive dancing. Move over, John Travolta.

The Commodore VIC-20 computer and 1541 disk drive make a very powerful computing combination. The VIC-20, of course, is a full-fledged 6502-based computer, offering many professional features such as a thorough set of Basic commands, a professional keyboard and expandable memory options.

A beginning system often starts with a cassette unit for mass storage, but as the user's level of expertise rises and the need for faster I/O becomes more important, a disk drive becomes essential. The 1541 drive, like all Commodore's floppy disk units, is intelligent. This means it is a computer in its own right and is able to perform many functions without the intervention of the host computer.

In fact, the 1541 contains its own 6502 microprocessor, a couple of VIAs (versatile interface adapters), 2K of RAM and a complete operating system in ROM. This leads to two important facts. First, since the 1541's system is so complete, it steals no user program RAM from the host computer. Unlike many disk drive/computer combinations, a VIC-20 has just as much program space with disk drive as without it.

Second, since the 1541 is intelligent, you can externally program it to perform many useful functions. The unit is essentially open-ended in the sense that if a particular function doesn't already exist in the disk operating system, you may write a program to generate such a function.

RUN It Right

Editor/assembler or
machine language monitor program
VIC-20
1514 Disk Drive

Address author correspondence to Thomas Henry, Transonic Laboratories, 249 Norton St., Mankato, MN 56001.

DISK-O-VIC

This article describes a utility

package, called DISK-O-VIC, which adds thirteen new disk-related commands to the VIC-20. These commands become part of Basic and you may use them in the immediate mode to simplify disk drive housekeeping operations. Some of the commands, such as DLOAD and DSAVE, are extensions of old Basic commands. Others, like Scratch and Rename, are for keeping disks neat and orderly. Finally, another group adds features such as error message readout, directory display and so on.

The DISK-O-VIC utility package is written in machine language for maximum speed and flexibility. After it has been loaded and initialized, it may be left in place for an entire programming session. Due to the special loader feature (described later), DISK-O-VIC will sit at the top of memory and be free from Basic program interference. Thus, it adds thirteen new commands while remaining transparent to the normal operating system.

The special loader feature also makes it possible to use this package in a VIC-20 with any amount of extra memory. It will not become obsolete if you decide to add extra memory at a later date. After installation and initialization, DISK-O-VIC consumes 980 bytes and leaves zero page intact.

Thirteen New Disk Commands

Before describing DISK-O-VIC's mode of operation, I'll examine the new commands so you can see just what they do. (For full details, see the accompanying table of commands.)

Whenever a floppy disk is inserted into the 1541 and is subsequently accessed, a special chart, called the block availability map, is created in the drive's memory. This chart contains special information about the disk currently in the drive, such as how the disk has been partitioned, what blocks are free and other various allocation matters. Fortunately, the disk drive keeps track of this somewhat esoteric information, so you rarely need to be concerned with it.

The process of creating this chart is called initialization. You must initialize a disk if it is to be properly written to or read from. (Note that some non-Commodore disk drive systems use the term initialization to mean "format the disk," a process which can write over or destroy data. This is not the case with the 1541 disk drive.)

To ensure that the information in the drive's memory is up to date, you should initialize the disk often during a session.

Listing 1. DISK-O-VIC, a disk utility program for the VIC-20. Note: This is an assembly language program; an editor/assembler is necessary to run it.

```
LINE# LOC   CODE        LINE

00001 0000              ;**********************************
00002 0000              ;*                                *
00003 0000              ;*           DISK-O-VIC           *
00004 0000              ;*      DISK UTILITY PACKAGE      *
00005 0000              ;*    FOR THE VIC-20 COMPUTER     *
00006 0000              ;*                                *
00007 0000              ;*         THOMAS HENRY           *
00008 0000              ;*      TRANSONIC LABORATORIES    *
00009 0000              ;*        249 NORTON STREET       *
00010 0000              ;*        MANKATO, MN 56001       *
00011 0000              ;*                                *
00012 0000              ;**********************************
00013 0000              ;
00014 0000              ;
00015 0000              PARPTR = $0B          ;PARSER POINTER.
00016 0000              POINTR = $22          ;VIC-20 UTILITY POINTER.
00017 0000              BASIC  = $2B          ;START OF BASIC POINTER.
00018 0000              VARBLE = $2D          ;START OF VARIABLES POINTER.
00019 0000              CHRGET = $73          ;BASIC CHRGET ROUTINE.
00020 0000              CHRGOT = $79          ;RE-GET OLD CHARACTER.
00021 0000              CHRPTR = $7A          ;CHRGET POINTER.
00022 0000              WEDGE  = $7E          ;CHRGET BASIC WEDGE.
00023 0000              ST     = $90          ;STATUS WORD 'ST'.
00024 0000              CHRNOS = $B7          ;NUMBER OF CHAR'S IN NAME.
00025 0000              DEVICE = $BA          ;CURRENT DEVICE.
00026 0000              UTILPT = $FB          ;DISK-O-VIC UTILITY POINTER.
00027 0000              FIRCHR = $FD          ;TEMPORARY SAVE FOR CATALOG.
00028 0000              SECCHR = $FE          ;TEMPORARY SAVE FOR CATALOG.
00029 0000              STACK  = $0100        ;SYSTEM STACK.
00030 0000              BUFFER = $0200        ;INPUT BUFFER.
00031 0000              CMDBUF = $033C        ;DISK COMMAND BUFFER.
00032 0000              FLAG   = CMDBUF       ;FLAG FOR CATALOG.
00033 0000              WARMST = $C474        ;BASIC WARM START.
00034 0000              WAIT   = $C48C        ;WAIT FOR COMMAND EXIT.
00035 0000              INFIN  = $C49F        ;FINISH INPUTTING LINE.
00036 0000              CHAIN  = $C533        ;REBUILD BASIC LINE CHAINING.
00037 0000              CLR    = $C659        ;ADJUST POINTERS, RESET BASIC.
00038 0000              INTEGR = $C96B        ;FETCH INTEGER INPUT.
00039 0000              PSTRNG = $CB1E        ;PRINT STRING AIMED BY (A,Y).
00040 0000              ERROR  = $CF08        ;SYNTAX ERROR ROUTINE.
00041 0000              PRLINE = $DDCD        ;PRINT LINE NUMBER.
00042 0000              CHROUT = $E742        ;OUTPUT TO SCREEN.
00043 0000              RESET  = $FD22        ;VIC-20 COLD START.
00044 0000              SECLIS = $FF93        ;SECONDARY AFTER LISTEN.
00045 0000              TKSA   = $FF96        ;SECONDARY AFTER TALK.
00046 0000              ACPTR  = $FFA5        ;ACCEPT DATA FROM RS-232.
00047 0000              CIOUT  = $FFA8        ;OUTPUT BYTE TO RS-232.
00048 0000              UNTALK = $FFAB        ;UNTALK THE DEVICE.
00049 0000              UNLIST = $FFAE        ;UNLISTEN DEVICE.
00050 0000              LISTEN = $FFB1        ;COMMAND DEVICE TO LISTEN.
00051 0000              TALK   = $FFB4        ;COMMAND DEVICE TO TALK.
00052 0000              SETLFS = $FFBA        ;SET LOGICAL FILE.
00053 0000              SETNAM = $FFBD        ;SET THE FILE NAME.
00054 0000              OPEN   = $FFC0        ;OPEN A FILE.
00055 0000              CLOSE  = $FFC3        ;CLOSE A FILE.
00056 0000              CLRCHN = $FFCC        ;RESTORE DEFAULT DEVICES.
00057 0000              INPUT  = $FFCF        ;INPUT A BYTE.
00058 0000              OUTPUT = $FFD2        ;OUTPUT A BYTE.
00059 0000              LOAD   = $FFD5        ;LOAD RAM FROM DEVICE.
00060 0000              SAVE   = $FFD8        ;SAVE RAM TO DEVICE.
00061 0000              STOP   = $FFE1        ;CHECK STOP KEY.
00062 0000              GETIN  = $FFE4        ;GET A KEYSTROKE.
00063 0000              ;
00064 0000              ;
00065 0000                     * = $1000
00067 1000              ;
00068 1000              ;
00069 1000              ;DISK-O-VIC INITIALIZATION
00070 1000              ;
00071 1000              ;
00072 1000  A2 00              LDX #SYSTM1-SYSTM1 ;INDEX NEW SYSTEM.
00073 1002  A0 00        CROSS LDY #$00
00074 1004  BD 54 13     PUTIN LDA SYSTM1,X     ;LOAD IN OPCODE AND
00075 1007  F0 07              BEQ INSTAL       ;INSTALL IN WEDGE.
00076 1009  99 7E 00           STA WEDGE,Y      ;ZERO MEANS END OF WEDGE.
00077 100C  C8                 INY
00078 100D  E8                 INX              ;PUT IN NEXT OPCODE.
00079 100E  D0 F4              BNE PUTIN        ;BRANCH ALWAYS.
00080 1010  4C 74 C4     INSTAL JMP WARMST      ;JUMP TO WARM START.
00081 1013              ;
00082 1013              ;
00083 1013              ;START OF WEDGE INSERT
00084 1013              ;
00085 1013              ;
00086 1013  B0 0A        INSERT BCS NORM        ;END OF NORMAL CHRGET.
00087 1015  C9 20              CMP #$20
00088 1017  F0 32              BEQ REGET        ;IGNORE SPACES.
00089 1019  38                 SEC
00090 101A  E9 30              SBC #$30
00091 101C  38                 SEC
00092 101D  E9 D0              SBC #$D0
00093 101F  8D BE 13     NORM  STA ASAVE        ;SAVE THE ACCUMULATOR.
00094 1022  08                 PHP
00095 1023  68                 PLA
```

More →

The 1541, as it comes from the factory, will generally perform self-initialization during the execution of various commands. To add a margin of safety, an automatic initialization precedes every command in DISK-O-VIC. Though this may be somewhat redundant, the process takes only a second and goes a long way toward reducing problems. It never hurts to over-initialize!

The DLOAD and DSAVE commands work exactly like the VIC-20's

Table 1. Explanation of DISK-O-VIC commands.

Append. This command allows a program from disk to be appended onto another in memory. To keep things simple for the VIC-20, it is important that the program in memory have line numbers less than the disk program to be appended. The availability of this command makes it possible to build large subroutine libraries from which complete programs may be assembled. The proper syntax is:

APPEND "title of program" [return]

As with normal VIC-20 Basic, some abbreviations are possible. For example, instead of typing in the whole word APPEND, you may type "A shift-P." (All of DISK-O-VIC's commands may be abbreviated in this fashion. Just type the first letter of the command, followed by the second letter shifted.)

Catalog. To determine what is on the disk currently in the drive unit, type CATALOG and hit the return key. A directory listing will be printed to the screen so you can see all of the programs available. Note that unlike the method for looking at the directory normally employed by the 1541, Catalog will not disturb the program sitting in the VIC-20's memory.

As an added convenience, a special pause feature has been added. Push the space bar once to pause the listing. Push it again to resume. You may also hit the run/stop key to terminate a listing.

Collect. Type this command and hit the return key, and the disk in the drive will be validated or collected. In simple terms, this will cause the 1541 drive unit to trace through the entire disk, making sure that all of the blocks are properly "connected." Any blocks that have been improperly allocated will be cleaned up and made available for more storage. The entire operation of this command is fairly complex, but basically it simply looks over the disk and tidies it up. Like initialization, it never hurts to use the Collect command often.

DLOAD. Acts just like the normal Load command but defaults to the disk drive automatically. For example, type DLOAD "program name" and hit the return key. The drive is automatically initialized, the program loaded and disk errors checked for. Just to put this into perspective, DLOAD is equivalent to the following steps:

```
OPEN 1,8,15,"I"
LOAD "program name",8
INPUT#1 disk error message, etc.
CLOSE 1
```

It is clear that DLOAD, though a simple command, does quite a lot. Incidentally, DLOAD may only be used for Basic programs or machine language programs that "look" like Basic. This limitation is due to the fact that the VIC-20 has a strange "sliding memory" loading format.

DSAVE. This is just like DLOAD, but saves a Basic program to the disk. The same initialization and error detection take place.

Header. This is a special command that takes a virgin disk and formats it for later use. Magnetic marks, which serve as guides to the 1541, are imprinted on the disk, and a title and identification code are assigned to it. The syntax for its use is:

HEADER "disk name",Ixx [return]

where "disk name" is the name to be assigned to the disk. "xx" has been used here as the identification code. However, any two-character combination may be used. Note that the comma is necessary, as is the letter "I." Before the disk is headered, the query "Are You Sure? (Y/N)" is printed to the screen. An answer of "Y" will start the command; any other response will abort the process. Since the Header command overwrites the disk, it's important to provide this "Are You Sure?" feature.

INIT. As mentioned previously, every DISK-O-VIC command has automatic initialization built in. However, there may be times when a disk is acting troublesome and it is desired to force an initialization. To do so, simply type INIT, hit the return key and the disk will be initialized. This command is equivalent to typing

```
OPEN 1,8,15,"I"
CLOSE 1
```

Kill. This is a self-destruct command. When you have had enough of DISK-O-VIC for a programming session and wish to remove it from the computer entirely, type KILL and hit the return key. The computer will go through an entire reset, acting as though you had shut it off and then turned it on again. Do not confuse this command with Off (see below). Kill completely resets the computer. In general, use this command only when you wish to cause a cold start.

Off. This command turns off DISK-O-VIC, but leaves it in memory, safe and protected. Thus it may be returned to whenever desired. Since DISK-O-VIC slows Basic down somewhat, you may wish to turn it off whenever you're running a program to attain maximum speed. To turn it back on, simply type

SYS 256*PEEK(56)+PEEK(55) [return]

Rename. This command will rename a program on disk, without affecting any program already in memory. For example,

RENAME "old name" TO "new name" [return]

will change the name of the program to "new name." There are several things to note. The old name comes first, then the new name. The word "TO" must be present between the two names for the command to work. Finally, error detection is provided, so that it is impossible to Rename a file to a name currently in use.

Scratch. This command lets you scratch a file or program from the disk. Simply type SCRATCH followed by the name of the file, and hit the return key. Once again, the query "Are You Sure? (Y/N)" is presented. A response of "Y" will cause the file to be scratched.

Send. This is a general purpose command and can be used to send some of the standard Commodore disk commands to the drive unit. For example,

SEND "I" [return]

will send the letter I to the disk, and thus cause an initialization. (Of course, DISK-O-VIC's command, INIT, will do the same thing.) As another example,

SEND "R:new name=old name" [return]

will cause the file "old name" to be renamed. Since other commands in DISK-O-VIC cover most contingencies, the Send command is probably not needed often. But it's nice to have it handy for advanced disk programming operations. For the record, Send is equivalent to

```
OPEN 1,8,15,"command"
CLOSE 1
```

Status. This is a troubleshooting command that allows you to chase down the cause of a disk operation failure. If the red error light on your disk drive comes on, type STATUS and hit the return key. The light will go off, and an error message will be printed to the screen. This message will describe the error and where on the disk (in terms of track and sector) the problem was encountered. If everything is OK, no message is printed. To test this command, type the following:

OPEN 1,8,1,"GARBAGE" [return]

The 1541 drive will whir, and assuming that there isn't a file named "GARBAGE" on the disk, the error light should come on. Type STATUS, and the error message will be printed to the screen. Refer to the 1541 disk drive manual for a full explanation of the error messages.

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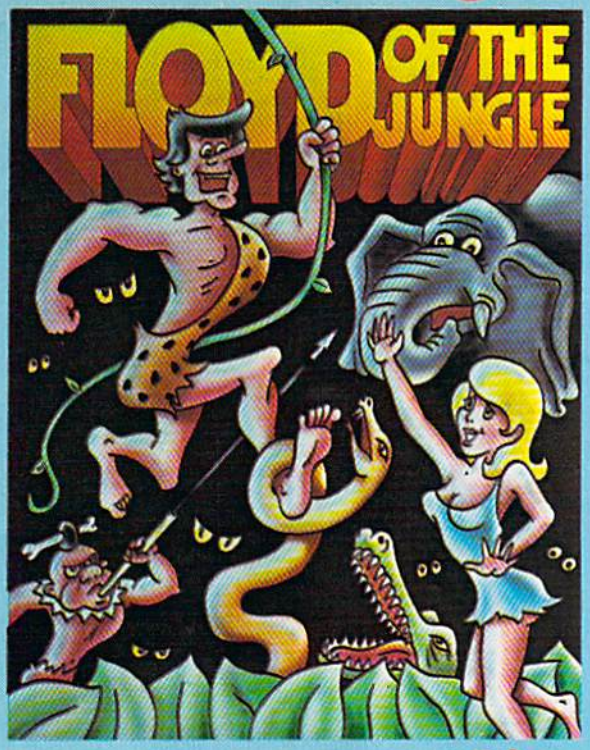

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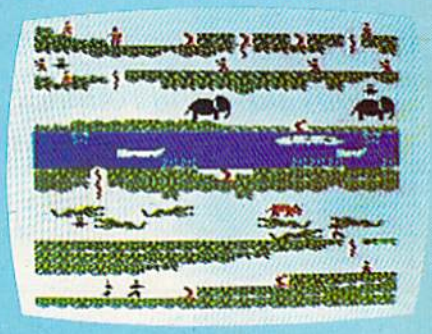

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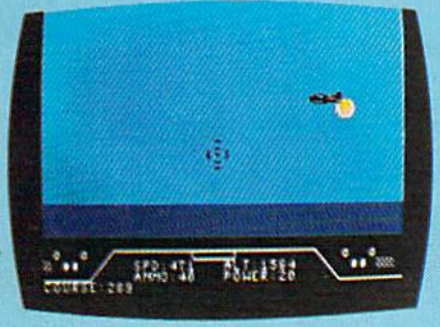

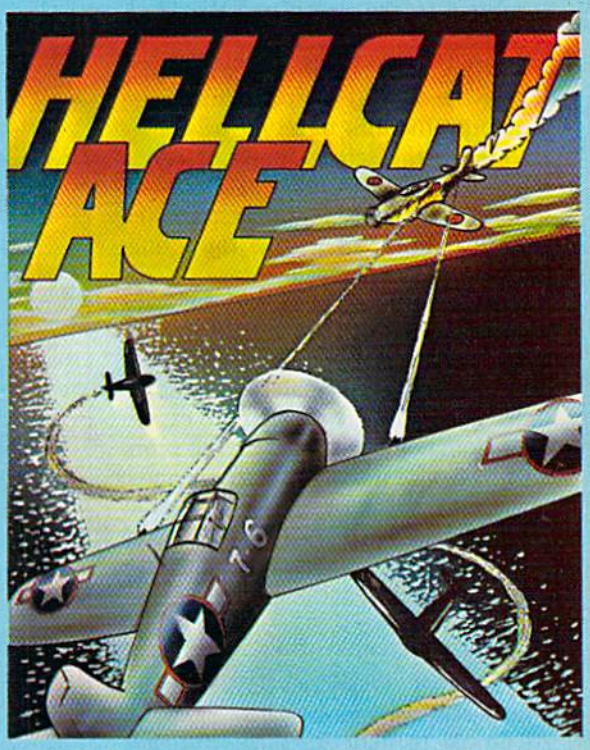

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Load and Save commands, except that the computer knows automatically that the proper device to access is the disk drive (device number eight). These commands are for Basic programs only. Do not try to DLOAD or DSAVE machine language or hybrid programs, for the commands make certain assumptions about the start of program space that may or may not be true for machine language programs. In general, all the commands in DISK-O-VIC assume you are working in Basic.

DISK-O-VIC untaps many powerful routines contained in the VIC-20 ROM.

DLOAD and DSAVE automatically check the error channel after an operation to see that all went well. If an error is detected (Drive Not Ready, File Exists, File Not Found, etc.), the message is printed to the screen and the file is closed down.

Catalog is an interesting command. Unlike the old way of doing things, you may print the disk directory or catalog directly to the screen, thus preserving any programs in memory. To stop the listing to the screen, simply push the space bar once; to resume the listing, push the space bar again.

The purpose of the rest of the commands should be obvious. Just look over Table 1 and perhaps refer to the 1541 disk drive manual from time to time. Users of larger (and more expensive) Commodore computers will probably recognize many of the commands. Unlike the VIC-20, computers such as the PET and SUPERPET already have a set of disk commands very similar to those provided by DISK-O-VIC.

How the Program Works

Now that DISK-O-VIC has been introduced, we'll look at how it works. As an aid to understanding, Listing 1 presents an assembler listing for the complete program. Since assemblers are starting to become more common for the VIC-20, you may wish to enter the source code and assemble your own version. But the assembler listing has been provided for its educational value, and

Listing 1 continued.

```
00096  1024  8D BD 13          STA SSAVE        ;SAVE STATUS REGISTER.
00097  1027  8E BF 13          STX XSAVE        ;SAVE THE X REGISTER.
00098  102A  8C C0 13          STY YSAVE        ;SAVE THE Y REGISTER.
00099  102D  BA                TSX
00100  102E  BD 01 01          LDA STACK+1,X    ;EXAMINE PUSHED ADDRESSES
00101  1031  C9 BC             CMP #<WAIT       ;TO SEE IF WE CAME FROM
00102  1033  D0 07             BNE COMMON       ;'WAIT' (WAITING FOR A
00103  1035  BD 02 01          LDA STACK+2,X    ;COMMAND ROUTINE).
00104  1038  C9 C4             CMP #>WAIT
00105  103A  F0 12             BEQ VCDISK       ;YES WE DID, GO ON.
00106  103C  AC C0 13    COMMON LDY YSAVE        ;NO, WE DIDN'T.
00107  103F  AE BF 13          LDX XSAVE        ;MUST BE A COMMON CHRGET
00108  1042  AD BD 13          LDA SSAVE        ;OPERATION, SO RESTORE ALL
00109  1045  48                PHA              ;REGISTERS AND CONTINUE.
00110  1046  AD BE 13          LDA ASAVE
00111  1049  28                PLP
00112  104A  60                RTS
00113  104B  4C 73 00    REGET  JMP CHRGET
00114  104E                    ;
00115  104E                    ;
00116  104E                    ;PARSER ROUTINE
00117  104E                    ;
00118  104E                    ;
00119  104E  AD BD 13    VCDISK LDA SSAVE        ;LOOK AT OLD STATUS REG:
00120  1051  4A                LSR A            ;WAS INPUT A LINE# ?
00121  1052  90 3A             BCC NUMBER       ;YES, GO ELSEWHERE.
00122  1054  A2 00             LDX #$00         ;NO, IT WAS A COMMAND.
00123  1056  86 0B             STX PARPTR       ;INDEX INTO THE COMMANDS.
00124  1058  A4 7A       PARSER LDY CHRPTR       ;ADDR OF CHAR IN COMMAND.
00125  105A  B9 00 02    CHECK  LDA BUFFER,Y     ;GET THE COMMAND CHARACTER.
00126  105D  38                SEC
00127  105E  FD 5C 13          SBC KEYWRD,X     ;COMPARE TO TABLE.
00128  1061  F0 13             BEQ DIRECT       ;DIRECT MATCH!
00129  1063  C9 80             CMP #$80
00130  1065  F0 13             BEQ SHIFT        ;LETTER MATCHES BY A 'SHIFT'.
00131  1067  E6 0B             INC PARPTR       ;KEEP TRACK OF POSITION.
00132  1069  E8          MOVE   INX              ;NOT THE RIGHT KEYWORD, SO
00133  106A  BD 5B 13          LDA KEYWRD-1,X   ;MOVE X TO POINT TO NEXT
00134  106D  10 FA             BPL MOVE         ;WORD IN THE TABLE.
00135  106F  BD 5C 13          LDA KEYWRD,X
00136  1072  D0 E4             BNE PARSER       ;CHECK FOR NEXT KEYWORD.
00137  1074  F0 C6             BEQ COMMON       ;USED UP ALL KEYWORDS.
00138  1076  E8          DIRECT INX              ;MATCHES SO FAR, BUT
00139  1077  C8                INY              ;CHECK NEXT LETTER.
00140  1078  D0 E0             BNE CHECK        ;BRANCH ALWAYS.
00141  107A  84 7A       SHIFT  STY CHRPTR       ;POINT CHRPTR AT FINAL BYTE.
00142  107C  A5 0B             LDA PARPTR       ;FIND POSITION OF COMMAND.
00143  107E  0A                ASL A            ;MULTIPLY BY TWO SINCE
00144  107F  AA                TAX              ;ADDRESS IS TWO BYTES.
00145  1080  BD A4 13          LDA ACTION+1,X   ;LOAD IN THE PROPER
00146  1083  48                PHA              ;ROUTINE ADDRESS BY PUSHING
00147  1084  BD A3 13          LDA ACTION,X     ;INTO THE STACK.
00148  1087  48                PHA
00149  1088  20 3C 10          JSR COMMON       ;RESTORE ALL REGISTERS.
00150  108B  4C 73 00          JMP CHRGET       ;GO FINISH LINE INPUT.
00151  108E                    ;
00152  108E                    ;
00153  108E                    ;AT THIS POINT THE ROUTINE JUMPS TO 'CHRGET'
00154  108E                    ;WHICH WILL AIM 'CHRPTR' AT THE NEXT BYTE.
00155  108E                    ;EVENTUALLY THE SUBROUTINE CALLED 'COMMON'
00156  108E                    ;WILL BE FOUND.  WHEN THE 'RTS' AT THE END
00157  108E                    ;IS HIT, CONTROL WILL TRANSFER TO THE
00158  108E                    ;COMMAND ACTION ADDRESS PUSHED ON THE STACK.
00159  108E                    ;
00160  108E                    ;
00161  108E  68          NUMBER PLA              ;DISABLE NORMAL RTS ADDRESS.
00162  108F  68                PLA
00163  1090  20 3C 10          JSR COMMON       ;RESTORE ALL REGISTERS.
00164  1093  20 6B C9          JSR INTEGR       ;GET THE LINE NUMBER.
00165  1096  4C 9F C4          JMP INFIN        ;FINISH LINE INPUT.
00166  1099                    ;
00167  1099                    ;
00168  1099                    ;*** 'APPEND' COMMAND ENTRY ***
00169  1099                    ;
00170  1099                    ;
00171  1099  A0 02       APPEND LDY #$02
00172  109B  A5 2D       DECREM LDA VARBLE       ;DECREMENT THE END OF
00173  109D  D0 02             BNE ONCE         ;PROGRAM POINTER TWICE.
00174  109F  C6 2E             DEC VARBLE+1
00175  10A1  C6 2D       ONCE   DEC VARBLE
00176  10A3  88                DEY
00177  10A4  D0 F5             BNE DECREM       ;DO AGAIN, IF NEEDED.
00178  10A6  A5 2D             LDA VARBLE       ;THEN AIM THE APPEND
00179  10A8  85 FB             STA UTILPT       ;ROUTINE TO THIS LOCATION.
00180  10AA  A5 2E             LDA VARBLE+1
00181  10AC  85 FC             STA UTILPT+1
00182  10AE  4C 3C 11          JMP LOADSB       ;PERFORM RELOCATING LOAD.
00183  10B1                    ;
00184  10B1                    ;
00185  10B1                    ;*** 'CATALOG' COMMAND ENTRY ***
00186  10B1                    ;
00187  10B1                    ;
00188  10B1  20 EA 12    CAT    JSR ICMD         ;INITIALIZE DISK.
00189  10B4  A9 24             LDA #'$          ;COMMAND FOR CATALOG.
00190  10B6  8D 3C 03          STA CMDBUF
00191  10B9  A2 3C             LDX #<CMDBUF     ;GET ADDRESS OF COMMAND.
00192  10BB  A0 03             LDY #>CMDBUF
00193  10BD  A9 01             LDA #$01         ;LENGTH OF COMMAND.
00194  10BF  20 BD FF          JSR SETNAM       ;SET THE NAME.
00195  10C2  A9 0E             LDA #$0E         ;FILE NUMBER.
```

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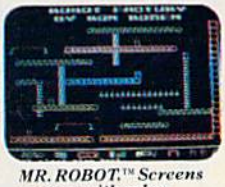

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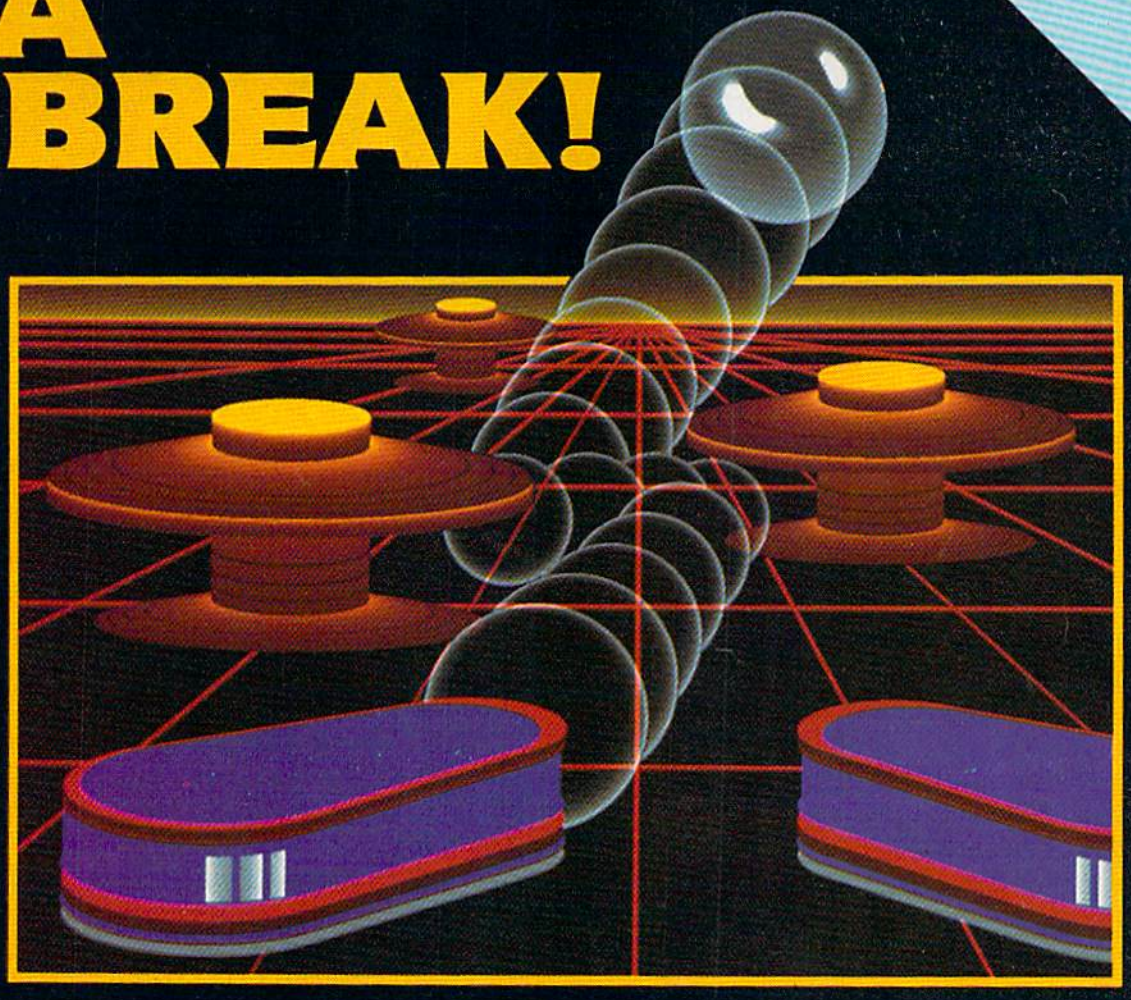

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Listing 1 continued.

```
00196  10C4  A0 60          LDY #$60        ;SECONDARY ADDRESS.
00197  10C6  A2 08          LDX #$08        ;DEVICE NUMBER.
00198  10C8  20 BA FF       JSR SETLFS      ;SET THE LOGICAL FILE.
00199  10CB  20 C0 FF       JSR OPEN        ;OPEN THE FILE.
00200  10CE  A9 08          LDA #$08
00201  10D0  20 B4 FF       JSR TALK        ;FORCE A TALK.
00202  10D3  A9 60          LDA #$60        ;SEND THE COMMAND NOW.
00203  10D5  20 96 FF       JSR TKSA
00204  10D8  A9 00          LDA #$00        ;ZERO OUT THE ST.
00205  10DA  85 90          STA ST
00206  10DC  A0 03          LDY #$03        ;SKIP INITIAL ADDRESSES.
00207  10DE  8C 3C 03  THREAD STY FLAG      ;SAVE THE SKIP COUNT.
00208  10E1  20 A5 FF       JSR ACPTR       ;GET A CHARACTER.
00209  10E4  85 FD          STA FIRCHR      ;SAVE FIRST CHARACTER.
00210  10E6  A4 90          LDY ST          ;CHECK THE ST.
00211  10E8  D0 39          BNE BADSTA      ;BRANCH IF BAD.
00212  10EA  20 A5 FF       JSR ACPTR       ;GET NEXT CHARACTER.
00213  10ED  85 FE          STA SECCHR      ;SAVE SECOND CHARACTER.
00214  10EF  A4 90          LDY ST          ;CHECK AGAIN.
00215  10F1  D0 30          BNE BADSTA      ;BRANCH IF BAD.
00216  10F3  AC 3C 03       LDY FLAG        ;HOW MANY BYTES HAVE
00217  10F6  88             DEY             ;WE DISPENSED WITH?
00218  10F7  D0 E5          BNE THREAD      ;NOT ENOUGH.
00219  10F9  A6 FD          LDX FIRCHR      ;GET FIRST CHARACTER.
00220  10FB  A5 FE          LDA SECCHR      ;GET SECOND CHARACTER.
00221  10FD  20 CD DD       JSR PRLINE      ;PRINT THE BLOCK COUNT.
00222  1100  20 39 13       JSR SPACE       ;PRINT A SPACE.
00223  1103  20 A5 FF  CONTEN JSR ACPTR     ;GET A CHARACTER.
00224  1106  A6 90          LDX ST          ;CHECK THE ST.
00225  1108  D0 19          BNE BADSTA      ;GO IF DONE.
00226  110A  C9 00          CMP #$00        ;0 = END OF LINE.
00227  110C  F0 0E          BEQ FINLIN      ;FINISH THE LINE.
00228  110E  20 D2 FF       JSR OUTPUT      ;OTHERWISE, PRINT CHAR.
00229  1111  20 E1 FF       JSR STOP        ;CHECK THE STOP KEY.
00230  1114  F0 0D          BEQ BADSTA      ;BRANCH IF PUSHED.
00231  1116  20 27 13       JSR PAUSE       ;PAUSE IF NEEDED.
00232  1119  4C 03 11       JMP CONTEN      ;PRINT NEXT ENTRY.
00233  111C  20 36 13  FINLIN JSR CARRET    ;PRINT CARRIAGE RETURN.
00234  111F  A0 02          LDY #$02        ;GO TO NEXT LINE.
00235  1121  D0 BB          BNE THREAD      ;BRANCH ALWAYS.
00236  1123  A9 0E     BADSTA LDA #$0E      ;CLOSE THE FILE.
00237  1125  20 C3 FF       JSR CLOSE
00238  1128  20 CC FF       JSR CLRCHN      ;RESTORE DEFAULT DEVICES.
00239  112B  4C 74 C4       JMP WARMST      ;RETURN TO BASIC.
00240  112E                ;
00241  112E                ;
00242  112E                ;*** 'COLLECT' COMMAND ENTRY ***
00243  112E                ;
00244  112E                ;
00245  112E  20 ED 12  COLLEC JSR CCMD       ;PERFORM COLLECT.
00246  1131  4C 74 C4       JMP WARMST      ;RETURN TO BASIC.
00247  1134                ;
00248  1134                ;
00249  1134                ;*** 'DLOAD' COMMAND ENTRY ***
00250  1134                ;
00251  1134                ;
00252  1134  A5 2B     DLOAD  LDA BASIC      ;THE PROGRAM WILL BE
00253  1136  85 FB            STA UTILPT     ;LOADED AT NORMAL BASIC
00254  1138  A5 2C            LDA BASIC+1    ;PROGRAM AREA.
00255  113A  85 FC            STA UTILPT+1
00256  113C  20 AE 12  LOADSB JSR PARAMS     ;GET PROGRAM NAME.
00257  113F  20 99 12       JSR SETDIS      ;SET UP ALL DISK PARAMETERS.
00258  1142  A9 00          LDA #$00        ;ZERO MEANS LOAD.
00259  1144  A6 FB          LDX UTILPT      ;RELOCATE THE LOAD TO
00260  1146  A4 FC          LDY UTILPT+1    ;THIS POINTER.
00261  1148  20 D5 FF       JSR LOAD        ;PERFORM THE LOAD.
00262  114B  20 33 C5       JSR CHAIN       ;REBUILD THE CHAINING.
00263  114E  A5 22          LDA POINTR      ;ADJUST START OF VARIABLES
00264  1150  A6 23          LDX POINTR+1    ;TO POINT RIGHT AFTER THE
00265  1152  18             CLC             ;THREE ZERO BYTES AT
00266  1153  69 02          ADC #$02        ;THE END OF THE PROGRAM.
00267  1155  85 2D          STA VARBLE
00268  1157  90 01          BCC NOADJ
00269  1159  E8             INX
00270  115A  86 2E     NOADJ  STX VARBLE+1
00271  115C  20 59 C6       JSR CLR         ;CLEAR ALL POINTERS, ETC.
00272  115F  4C 79 11       JMP CLEAN       ;GO CLEAN UP THE FILE.
00273  1162                ;
00274  1162                ;
00275  1162                ;*** 'DSAVE' COMMAND ENTRY ***
00276  1162                ;
00277  1162                ;
00278  1162  20 AE 12  DSAVE  JSR PARAMS     ;GET PROGRAM NAME.
00279  1165  20 99 12       JSR SETDIS      ;SET UP DISK PARAMETERS.
00280  1168  A5 2B          LDA BASIC       ;AIM 'UTILPT' AT
00281  116A  85 FB          STA UTILPT      ;START OF PROGRAM.
00282  116C  A5 2C          LDA BASIC+1
00283  116E  85 FC          STA UTILPT+1
00284  1170  A9 FB          LDA #<UTILPT    ;0-PAGE ADDRESS OF 'UTILPT'.
00285  1172  A6 2D          LDX VARBLE      ;X AND Y CONTAIN END
00286  1174  A4 2E          LDY VARBLE+1    ;OF PROGRAM ADDRESS.
00287  1176  20 D8 FF       JSR SAVE        ;SAVE TO DISK.
00288  1179  20 E5 12  CLEAN  JSR SHUT       ;CLOSE THE FILE.
00289  117C  20 53 12       JSR DERROR      ;CHECK FOR DISK ERRORS.
00290  117F  4C 74 C4       JMP WARMST      ;ALL DONE.
00291  1182                ;
00292  1182                ;
00293  1182                ;*** 'HEADER' COMMAND ENTRY ***
00294  1182                ;
00295  1182                ;
00296  1182  20 FA 12  HEADER JSR HDISK      ;PREPARE COMMAND.
```

More →

most users will want to enter the object code directly. A hexdump of this code is provided in Listing 2.

Most problems with detail can probably be cleared up by studying the comments in the listing. As an aid to understanding, however, I'll describe the basic structure of the program. To do this, some consideration must be given to the way Basic fetches and executes a command.

When interpretative Basic is in action, a pointer must seek commands by parsing or scanning the input line. The interpreter checks the input line, character by character, in hopes of finding a command that it recognizes. Thus, if you want to add new commands to Basic, you must put a "wedge" into the parser routine, diverting attention from the normal scanning procedure to a new one. Essentially, the parser is forced to look for the new commands first. If it can't match a command with any on the new list, then control is sent back to the normal system and it will check the input command against its old list.

The first block of code in Listing 1, lines 00072–00080, is the initialization routine. This code inserts a wedge into the normal parser routine, so initialization need occur only at the start of the session. After initialization, the Basic parser will always check first for DISK-O-VIC commands.

The next block of code occurs in lines 00086–00165. This is the parser add-on. As mentioned above, the parser will be directed to this routine each time a command is input to the computer. The key instruction in this block occurs at line 00100. The stack is examined for any "RTS" (return addresses). If the address on the top of the stack indicates that the parser has come from the VIC-20's "waiting for a command" state, then action is taken. If some other address is found, then the parser is allowed to continue its normal activity.

Assuming that the test has been passed and the VIC-20 is indeed waiting for a command, the input line is then checked character by character. This occurs in the block of code labeled "Parser Routine," lines 00119–00150. The input is checked against the list of DISK-O-VIC commands held in a table at lines 00573–00586. If a match is found, then an "action address" is formed, and control is passed to the proper subroutine.

Subroutines

The great bulk of the program is devoted to the various command subroutines. To make them easier to find,

Listing 1 continued.

```
00297  1185  20 B0 12        JSR STRING      ;THEN TACK ON DISK NAME.
00298  1188  20 73 00        JSR CHRGET      ;GET NEXT CHARACTER.
00299  118B  C9 2C           CMP #',         ;NEED A COMMA.
00300  118D  D0 2D           BNE BAD1        ;SYNTAX ERROR.
00301  118F  9D 3C 03        STA CMDBUF,X    ;PUT IN THE COMMA.
00302  1192  E8              INX
00303  1193  20 73 00        JSR CHRGET      ;GET DISK ID.
00304  1196  C9 49           CMP #'I         ;MUST HAVE AN 'I'.
00305  1198  D0 22           BNE BAD1
00306  119A  20 73 00        JSR CHRGET      ;GET ID NUMBER.
00307  119D  F0 1D           BEQ BAD1        ;BAD, IF NOT THERE.
00308  119F  9D 3C 03        STA CMDBUF,X    ;SAVE FIRST DIGIT.
00309  11A2  E8              INX
00310  11A3  20 73 00        JSR CHRGET      ;FETCH NEXT DIGIT.
00311  11A6  F0 14           BEQ BAD1        ;BAD IF NOT THERE.
00312  11A8  9D 3C 03        STA CMDBUF,X    ;SAVE SECOND DIGIT.
00313  11AB  E8              INX
00314  11AC  20 73 00        JSR CHRGET      ;EXTRANEOUS CHARACTERS?
00315  11AF  D0 0B           BNE BAD1        ;YES, BAD NEWS.
00316  11B1  9D 3C 03        STA CMDBUF,X    ;PUT ZERO FOR END.
00317  11B4  20 0F 13        JSR SURE        ;'ARE YOU SURE?'
00318  11B7  D0 09           BNE NOGO        ;NOT ZERO MEANS NO.
00319  11B9  4C 32 12        JMP XMIT        ;YES, DO HEADER.
00320  11BC  4C 08 CF  BAD1  JMP ERROR
00321  11BF                  ;
00322  11BF                  ;
00323  11BF                  ;*** 'INITIALIZE' COMMAND ENTRY ***
00324  11BF                  ;
00325  11BF                  ;
00326  11BF  20 EA 12  INIT  JSR ICMD        ;PERFORM INITIALIZATION.
00327  11C2  4C 74 C4  NOGO  JMP WARMST      ;ALL DONE!
00328  11C5                  ;
00329  11C5                  ;
00330  11C5                  ;*** 'KILL' COMMAND ENTRY ***
00331  11C5                  ;
00332  11C5                  ;
00333  11C5  20 22 FD  KILL  JSR RESET       ;DO A COLD START.
00334  11C8                  ;
00335  11C8                  ;
00336  11C8                  ;*** 'OFF' COMMAND ENTRY ***
00337  11C8                  ;
00338  11C8                  ;
00339  11C8  A2 04     OFF   LDX #SYSTM2-SYSTM1 ;CROSS OUT CURRENT WEDGE.
```

More

these subroutines have been arranged in alphabetical order, with Append coming first, then Catalog, and so on. Although at this point the program may look complex, it is actually quite easy to analyze if you attack one small function at a time.

Toward the end of the program, at line number 00452, some general purpose subroutines are presented. These are commonly used by the rest of the program to fetch file names, get disk parameters, print messages to the screen and so on. In general, they have been assigned labels or names that relate to the functions they perform.

DISK-O-VIC ends with various data and address tables. First is the table of keywords, described above. Then follows a table containing the addresses of the command subroutines. Finally, a set of variables is created for the purpose of saving registers and so forth. By assigning variables to this area, use of critical zero page locations is avoided.

Since details have a way of clouding the issue, here is a summary of the overall structure just described:

- Initialization
- The "wedge" into the parser

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Listing 1 continued.

```
00340  11CA  4C 02 10          JMP CROSS       ;PUT OLD CHRGET IN PLACE.
00341  11CD                  ;
00342  11CD                  ;
00343  11CD                  ;*** 'RENAME' COMMAND ENTRY ***
00344  11CD                  ;
00345  11CD                  ;
00346  11CD  20 FD 12    RENAME JSR RDISK       ;PREPARE COMMAND.
00347  11D0  20 79 00           JSR CHRGOT      ;GET NEXT CHARACTER.
00348  11D3  F0 E7              BEQ BAD1        ;NO NAME GIVEN, BAD.
00349  11D5  C9 22              CMP #'"
00350  11D7  D0 E3              BNE BAD1        ;NO START QUOTE IS BAD.
00351  11D9  A5 7A              LDA CHRPTR      ;SAVE POINTER TO OLD NAME.
00352  11DB  85 FB              STA UTILPT
00353  11DD  A5 7B              LDA CHRPTR+1
00354  11DF  85 FC              STA UTILPT+1
00355  11E1  20 73 00    TWIST   JSR CHRGET      ;GET PAST NEW NAME.
00356  11E4  F0 D6              BEQ BAD1        ;NONE GIVEN IS BAD.
00357  11E6  C9 22              CMP #'"         ;LOOK FOR END QUOTE.
00358  11E8  D0 F7              BNE TWIST
00359  11EA  20 73 00           JSR CHRGET      ;THEN LOOK FOR WORD 'TO'.
00360  11ED  C9 54              CMP #'T
00361  11EF  D0 CB              BNE BAD1
00362  11F1  20 73 00           JSR CHRGET
00363  11F4  C9 4F              CMP #'O
00364  11F6  D0 C4              BNE BAD1
00365  11F8  20 73 00           JSR CHRGET      ;FOUND IT.
00366  11FB  20 B0 12           JSR STRING      ;PUT LAST NAME IN FIRST.
00367  11FE  A9 3D              LDA #'=         ;PUT EQUALS SIGN IN.
00368  1200  9D 3C 03           STA CMDBUF,X
00369  1203  E8                 INX
00370  1204  A5 FB              LDA UTILPT      ;RESTORE OLD CHRPTR.
00371  1206  85 7A              STA CHRPTR
00372  1208  A5 FC              LDA UTILPT+1
00373  120A  85 7B              STA CHRPTR+1
00374  120C  20 B0 12           JSR STRING      ;PUT FIRST NAME IN LAST.
00375  120F  A9 00              LDA #$00        ;ZERO BYTE FOR END.
00376  1211  9D 3C 03           STA CMDBUF,X
00377  1214  4C 32 12           JMP XMIT        ;SEND THE COMMAND.
00378  1217                  ;
00379  1217                  ;
00380  1217                  ;*** 'SCRATCH' COMMAND ENTRY
00381  1217                  ;
00382  1217                  ;
```

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Listing 1 continued.

```
00383  1217  20 00 13    SCRATC JSR SDISK        ;SETUP 'S:' COMMAND.
00384  121A  20 B0 12           JSR STRING       ;TACK ON NAME.
00385  121D  A9 00              LDA #$00         ;PUT ZERO BYTE FOR END.
00386  121F  9D 3C 03           STA CMDBUF,X
00387  1222  20 0F 13           JSR SURE         ;'ARE YOU SURE?'
00388  1225  D0 29              BNE EGRESS       ;NO, IF NOT ZERO.
00389  1227  4C 32 12           JMP XMIT         ;GO PERFORM THE SCRATCH.
00390  122A                    ;
00391  122A                    ;
00392  122A                    ;*** 'SEND' COMMAND ENTRY ***
00393  122A                    ;
00394  122A                    ;
00395  122A  20 AE 12    SEND   JSR PARAMS       ;GET COMMAND STRING.
00396  122D  A9 00              LDA #$00         ;ZERO BYTE DENOTES
00397  122F  9D 3C 03           STA CMDBUF,X     ;END OF STRING.
00398  1232  20 EA 12    XMIT   JSR ICMD         ;INITIALIZE DISK.
00399  1235  20 DB 12           JSR RESPON       ;SET UP COMMAND CHANNEL.
00400  1238  A0 00              LDY #$00
00401  123A  B9 3C 03    SHOOT  LDA CMDBUF,Y     ;GET COMMAND STRING.
00402  123D  F0 06              BEQ SWEEP        ;ZERO MEANS END.
00403  123F  20 A8 FF           JSR CIOUT        ;OTHERWISE, SEND CHARACTER.
00404  1242  C8                 INY
00405  1243  90 F5              BCC SHOOT        ;BRANCH IF NO ERROR.
00406  1245  20 AE FF    SWEEP  JSR UNLIST       ;UN-LISTEN THE DISK.
00407  1248  20 53 12           JSR DERROR       ;CHECK DISK STATUS.
00408  124B  F0 03              BEQ EGRESS       ;BRANCH ALWAYS.
00409  124D                    ;
00410  124D                    ;
00411  124D                    ;*** 'STATUS' COMMAND ENTRY ***
00412  124D                    ;
00413  124D                    ;
00414  124D  20 53 12    STATUS JSR DERROR       ;CHECK DISK STATUS.
00415  1250  4C 74 C4    EGRESS JMP WARMST
00416  1253  A9 08       DERROR LDA #$08         ;GET READY TO READ
00417  1255  85 BA              STA DEVICE       ;THE ERROR CHANNEL.
00418  1257  20 B4 FF           JSR TALK         ;COMMAND BUS TO TALK.
00419  125A  A9 6F              LDA #$6F         ;THIS IS ERROR CHANNEL.
00420  125C  20 96 FF           JSR TKSA         ;SECONDARY ADDR. AFTER TALK.
00421  125F  A0 00              LDY #$00
00422  1261  20 A5 FF    XFER   JSR ACPTR        ;GET BYTE FROM BUS.
00423  1264  99 3C 03           STA CMDBUF,Y     ;SAVE IT UP HERE.
00424  1267  C8                 INY
00425  1268  C9 0D              CMP #$0D         ;LOOK FOR CARRIAGE RETURN.
00426  126A  D0 F5              BNE XFER         ;IF NOT, GET NEXT CHAR.
00427  126C  A9 00              LDA #$00         ;PUT ZERO BYTE FOR END.
00428  126E  99 3C 03           STA CMDBUF,Y
00429  1271  20 AB FF           JSR UNTALK       ;UNTALK THE CHANNEL.
00430  1274  A0 00              LDY #$00         ;CHECK FOR ASCII '00'.
00431  1276  A9 30              LDA #'0
00432  1278  D9 3C 03           CMP CMDBUF,Y
00433  127B  D0 06              BNE DEFER        ;DEFINITELY AN ERROR.
00434  127D  C8                 INY
00435  127E  D9 3C 03           CMP CMDBUF,Y
00436  1281  F0 15              BEQ NOERR        ;NO ERROR FOUND
00437  1283  20 E5 12    DEFER  JSR SHUT         ;CLOSE THE FILE.
00438  1286  20 CC FF           JSR CLRCHN       ;RESTORE DEFAULT DEVICES.
00439  1289  20 36 13           JSR CARRET       ;PRINT CARRIAGE RETURN.
00440  128C  A9 3C              LDA #<CMDBUF
00441  128E  A0 03              LDY #>CMDBUF
00442  1290  20 1E CB           JSR PSTRNG       ;PRINT THE ERROR MESSAGE.
00443  1293  68                 PLA              ;DON'T RETURN IF BAD.
00444  1294  68                 PLA
00445  1295  4C 74 C4           JMP WARMST       ;GO TO BASIC.
00446  1298  60          NOERR  RTS              ;RETURN TO CALLING ROUTINE.
00447  1299                    ;
00448  1299                    ;
00449  1299                    ;GENERAL PURPOSE SUBROUTINES
00450  1299                    ;
00451  1299                    ;
00452  1299  20 EA 12    SETDIS JSR ICMD         ;INITIALIZE DISK.
00453  129C  8A                 TXA              ;THIS IS NAME LENGTH.
00454  129D  A2 3C              LDX #<CMDBUF     ;X AND Y CONTAIN THE
00455  129F  A0 03              LDY #>CMDBUF     ;ADDRESS OF THE NAME.
00456  12A1  20 BD FF           JSR SETNAM       ;SET UP PROGRAM NAME.
00457  12A4  A9 08              LDA #$08         ;LOGICAL FILE NUMBER.
00458  12A6  AA                 TAX              ;DISK DEVICE NUMBER.
00459  12A7  A0 00              LDY #$00         ;SECONDARY FOR RELOCATING.
00460  12A9  84 90              STY ST           ;ZERO OUT 'ST'.
00461  12AB  4C BA FF           JMP SETLFS       ;SET UP FILE PARAMETERS.
00462  12AE                    ;
00463  12AE                    ;
00464  12AE  A2 00       PARAMS LDX #$00
00465  12B0  86 B7       STRING STX CHRNOS       ;SAVE ORIGINAL LENGTH.
00466  12B2  20 79 00           JSR CHRGOT       ;GET FILE NAME.
00467  12B5  F0 1F              BEQ BAD2         ;NO NAME GIVEN
00468  12B7  C9 22              CMP #'"          ;MUST HAVE A QUOTE.
00469  12B9  D0 1B              BNE BAD2
00470  12BB  E6 7A       PICKUP INC CHRPTR       ;UPDATE CHRGET POINTER.
00471  12BD  D0 02              BNE NOZER
00472  12BF  E6 7B              INC CHRPTR+1
00473  12C1  A0 00       NOZER  LDY #$00
00474  12C3  B1 7A              LDA (CHRPTR),Y   ;GET NEXT CHARACTER.
00475  12C5  F0 0A              BEQ DONE         ;ZERO IS END OF BUFFER.
00476  12C7  C9 22              CMP #'"          ;END-QUOTE YET?
00477  12C9  F0 06              BEQ DONE         ;YES, GOT THE STRING.
00478  12CB  9D 3C 03           STA CMDBUF,X     ;STORE HERE TEMPORARILY.
00479  12CE  E8                 INX
00480  12CF  D0 EA              BNE PICKUP       ;BRANCH ALWAYS.
00481  12D1  E4 B7       DONE   CPX CHRNOS       ;DON'T ALLOW ZERO
00482  12D3  F0 01              BEQ BAD2         ;LENGTH NAMES.
00483  12D5  60                 RTS
```

More

- The new parser routine
- The command subroutines
- General purpose subroutines
- Data, addresses and variables

Before leaving the theoretical aspects of DISK-O-VIC, we should look at the table of equates in the assembler listing. The table uses about a dozen zero-page locations, but since they are used for their normal purposes, the operating system takes little heed. Actually, locations $FB through $FE are free zero-page locations and are not used by the VIC-20 at all.

Since this is a disk operating system, it is assumed that the cassette tape unit won't be used. This frees a large block of space, starting at $033C, that is normally employed as a cassette buffer. This block can therefore be used for the disk command buffer. Even if a cassette unit is tied to the VIC-20 along with a floppy disk, no conflict should occur, since both units would rarely be accessed simultaneously.

ROM Routines

Next in the table of equates is a large group of subroutines contained in the VIC-20 operating system's ROM set. Even if you have no use for DISK-O-VIC, this table should prove to be helpful. By using standard ROM routines like these in homebrew programs, it is possible to save many hundreds, even thousands, of bytes. Let's examine a few of the routines in greater detail.

The VIC-20 ROM routines fall into two rough categories. The first group, called the Kernal, is composed of major routines for input and output operations. (For some unknown reason, "Kernal" is the spelling officially recognized by Commodore.) These Kernal routines are special in that several models of Commodore computers have the same routines occurring at identical addresses.

For example, the "output a byte" routine occurs at $FFD2 for *all* makes of Commodore computers. In general, however, the Kernal routines are all identical only for the VIC-20 and Commodore 64. This implies that software making extensive use of the Kernal should be simple to transfer from the VIC-20 to the Commodore 64, and vice versa.

The Basic commands are another category of routines. Their locations will vary from machine to machine, but are likely to be similar for all the Commodore computers. The routine at $CB1E, labeled PSTRNG in listing 1, is one of these. When called, it will print to the

(continued on p. 118)

Circle 46 on Reader Service card.

Merry Christmas!

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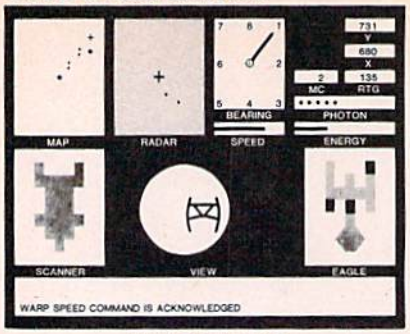

QUEST OF THE EAGLE

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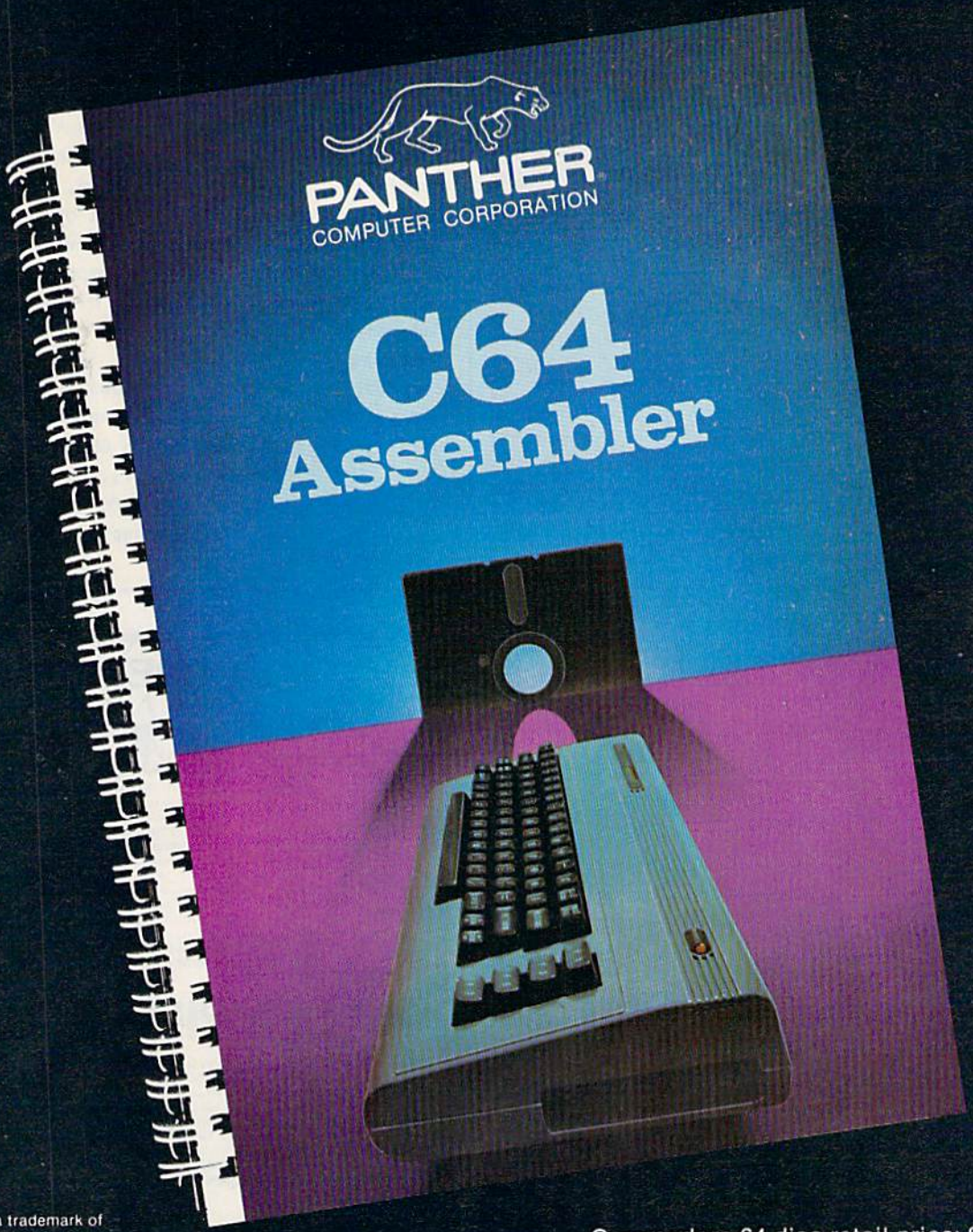
Listing 1 continued.

```
00484  12D6  68          BAD2   PLA              ;REMOVE OLD RETURN ADDRESS.
00485  12D7  68                 PLA
00486  12D8  4C 08 CF           JMP ERROR        ;GO TO ERROR ROUTINE.
00487  12DB                ;
00488  12DB                ;
00489  12DB  A9 08        RESPON LDA #$08         ;GET DISK NUMBER.
00490  12DD  20 B1 FF           JSR LISTEN       ;CAUSE DISK TO LISTEN.
00491  12E0  A9 6F              LDA #$6F         ;$6F = $0F OR $60.
00492  12E2  4C 93 FF           JMP SECLIS       ;SECONDARY AFTER LISTEN.
00493  12E5                ;
00494  12E5                ;
00495  12E5  A9 08        SHUT   LDA #$08         ;LOGICAL FILE NUMBER.
00496  12E7  4C C3 FF           JMP CLOSE        ;CLOSE THE FILE.
00497  12EA                ;
00498  12EA                ;
00499  12EA  A9 49        ICMD   LDA #'I          ;INITIALIZATION COMMAND.
00500  12EC  2C                 .BYTE $2C
00501  12ED  A9 56        CCMD   LDA #'V          ;VALIDATION COMMAND.
00502  12EF  48                 PHA              ;SAVE THE COMMAND.
00503  12F0  20 DB 12           JSR RESPON       ;SETUP COMMAND CHANNEL.
00504  12F3  68                 PLA              ;GET COMMAND AND
00505  12F4  20 A8 FF           JSR CIOUT        ;SEND IT.
00506  12F7  4C AE FF           JMP UNLIST       ;CAUSE AN UN-LISTEN.
00507  12FA                ;
00508  12FA                ;
00509  12FA  A9 4E        HDISK  LDA #'N          ;PREPARE HEADER COMMAND.
00510  12FC  2C                 .BYTE $2C
00511  12FD  A9 52        RDISK  LDA #'R          ;PREPARE RENAME COMMAND.
00512  12FF  2C                 .BYTE $2C
00513  1300  A9 53        SDISK  LDA #'S          ;PREPARE SCRATCH COMMAND.
00514  1302  A2 00              LDX #$00
00515  1304  9D 3C 03           STA CMDBUF,X     ;STORE COMMAND HERE.
00516  1307  E8                 INX
00517  1308  A9 3A              LDA #':          ;COLON IS COMMON TO ALL.
00518  130A  9D 3C 03           STA CMDBUF,X     ;STORE IT HERE.
00519  130D  E8                 INX              ;PREPARE FOR NEXT BYTE.
00520  130E  60                 RTS
00521  130F                ;
00522  130F                ;
00523  130F  A2 00        SURE   LDX #$00
00524  1311  BD 3E 13     SPEAK  LDA MESSAG,X     ;SEND MESSAGE:
00525  1314  F0 06              BEQ SILENT       ;'ARE YOU SURE?'
00526  1316  20 42 E7           JSR CHROUT
00527  1319  E8                 INX
00528  131A  D0 F5              BNE SPEAK        ;BRANCH ALWAYS.
00529  131C  20 CF FF     SILENT JSR INPUT        ;LOOK FOR Y = YES.
00530  131F  C9 59              CMP #'Y
00531  1321  08                 PHP
00532  1322  20 36 13           JSR CARRET       ;PRINT CARRIAGE RETURN.
00533  1325  28                 PLP
00534  1326  60                 RTS
00535  1327                ;
00536  1327                ;
00537  1327  20 E4 FF     PAUSE  JSR GETIN        ;GET A BYTE.
00538  132A  F0 09              BEQ NOWAIT       ;NONE THERE, GO ON.
00539  132C  C9 20              CMP #$20
00540  132E  D0 05              BNE NOWAIT       ;NOT A SPACE.
00541  1330  20 E4 FF     KEYUP  JSR GETIN        ;NOW WAIT FOR
00542  1333  F0 FB              BEQ KEYUP        ;ANOTHER KEYSTROKE.
00543  1335  60           NOWAIT RTS
00544  1336                ;
00545  1336                ;
00546  1336  A9 0D        CARRET LDA #$0D         ;PRINT CARRIAGE RETURN.
00547  1338  2C                 .BYTE $2C
00548  1339  A9 20        SPACE  LDA #$20         ;PRINT A SPACE.
00549  133B  4C D2 FF           JMP OUTPUT
00550  133E                ;
00551  133E                ;
00552  133E                ;DATA AND ANDRESS TABLE FOR DISK-O-VIC
00553  133E                ;
00554  133E                ;
00555  133E  0D           MESSAG .BYTE $0D
00556  133F  41 52               .BYTE 'ARE YOU SURE? (Y/N) '
00557  1353  00                  .BYTE $00
00558  1354  4C           SYSTM1 .BYTE $4C        ;NEW CHRGET.
00559  1355  13 10               .WORD INSERT
00560  1357  00                  .BYTE $00
00561  1358  B0           SYSTM2 .BYTE $B0, $0A  ;OLD CHRGET.
00561  1359  0A
00562  135A  C9                  .BYTE $C9, $00
00562  135B  00
00563  135C                ;
00564  135C                ;
00565  135C                ;TABLE OF DISK-O-VIC KEYWORDS
00566  135C                ;
00567  135C                ;
00568  135C                ;NOTE: THE EXTRA BYTE ON EACH LINE
00569  135C                ;IS THE LAST LETTER SHIFTED,
00570  135C                ;(ASCII + $80) FOR THE PARSER.
00571  135C                ;
00572  135C                ;
00573  135C  41 50        KEYWRD .BYTE 'APPEN', $C4
00573  1361  C4
00574  1362  43 41               .BYTE 'CATALO', $C7
00574  1368  C7
00575  1369  43 4F               .BYTE 'COLLEC', $D4
00575  136F  D4
00576  1370  44 4C               .BYTE 'DLOA', $C4
00576  1374  C4
00577  1375  44 53               .BYTE 'DSAV', $C5
```

(continued on p. 118)

The Assembler for the Commodore 64.



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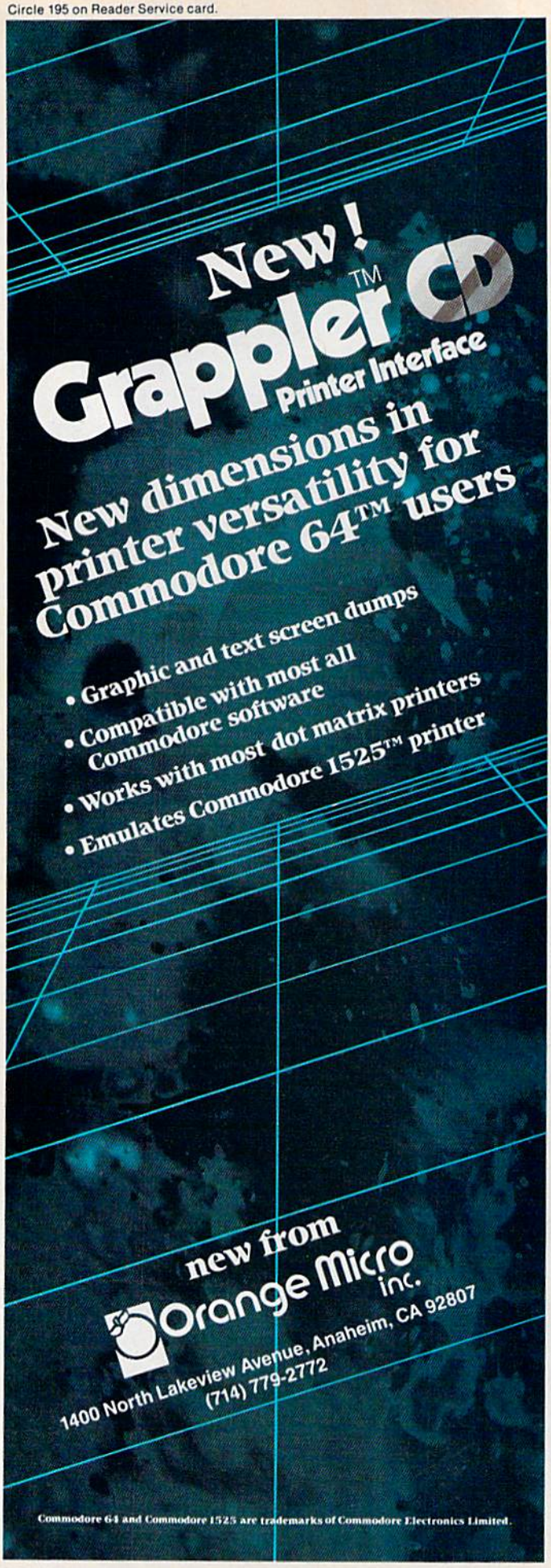
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(212) 683-6906
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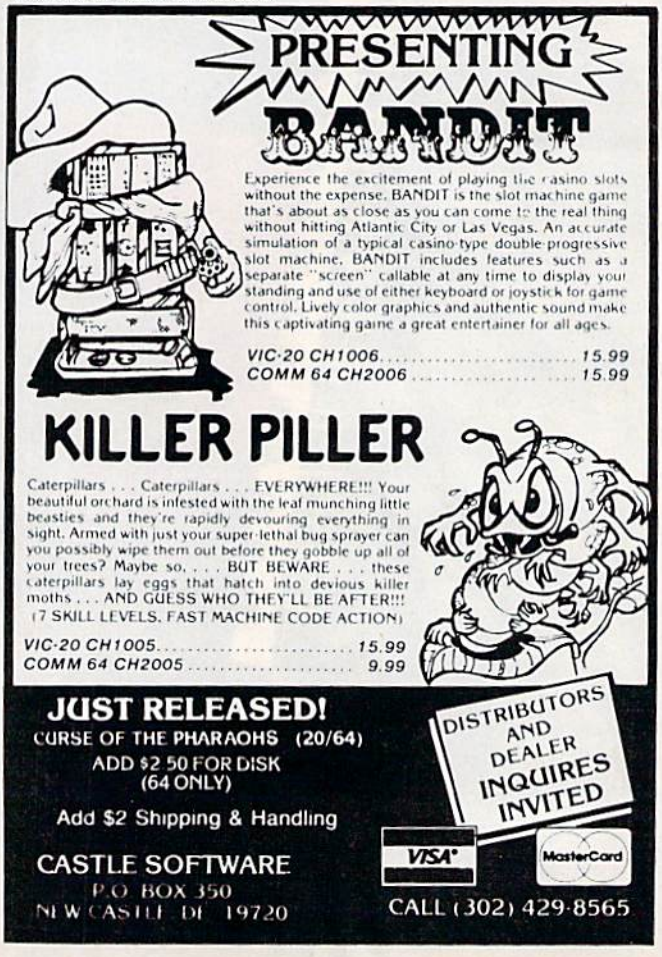
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Listing 2. Hexdump of the DISK-O-VIC utility. Note: A machine language monitor is necessary to run this listing.

```
 PC   IRQ   SR AC XR YR SP
B780 E455 34 33 38 36 F8

1000 00 1C 10 01 00 99 22 93
1008 11 11 12 22 A3 36 29 22
1010 44 49 53 4B 2D 4F 2D 56
1018 49 43 22 00 3A 10 02 00
1020 99 22 11 20 44 49 53 4B
1028 20 43 4F 4D 4D 41 4E 44
1030 20 50 41 43 4B 41 47 45
1038 22 00 53 10 03 00 99 A3
1040 34 29 22 46 4F 52 20 54
1048 48 45 20 56 49 43 2D 32
1050 30 22 00 62 10 04 00 99
1058 A3 31 30 29 22 11 42 59
1060 22 00 7A 10 05 00 99 A3
1068 35 29 22 11 54 48 4F 4D
1070 41 53 20 48 45 4E 52 59
1078 22 00 93 10 06 00 9E 32
1080 35 36 AC C2 28 34 34 29
1088 AA C2 28 34 33 29 AA 31
1090 34 38 00 00 00 A5 2D 85
1098 22 A5 2E 85 23 A5 37 85
10A0 24 A5 38 85 25 A0 00 A5
10A8 22 D0 02 C6 23 C6 22 B1
10B0 22 D0 3C A5 22 D0 02 C6
10B8 23 C6 22 B1 22 F0 21 85
10C0 26 A5 22 D0 02 C6 23 C6
10C8 22 B1 22 18 65 24 AA A5
10D0 26 65 25 48 A5 37 D0 02
10D8 C6 38 C6 37 68 91 37 8A
10E0 48 A5 37 D0 02 C6 38 C6
10E8 37 68 91 37 18 90 B6 C9
10F0 BF D0 ED A5 37 85 33 A5
10F8 38 85 34 6C 37 00 BF A2
1100 00 00 A0 00 00 BD 93 FF
1108 00 F0 07 99 7E 00 00 C8
1110 E8 D0 F4 4C 74 C4 B0 0A
1118 C9 20 F0 32 38 E9 30 38
1120 E9 D0 8D FD FF 00 08 68
1128 8D FC FF 00 8E FE FF 00
1130 8C FF FF 00 BA BD 01 01
1138 C9 8C D0 07 BD 02 01 C9
1140 C4 F0 12 AC FF FF 00 AE
1148 FE FF 00 AD FC FF 00 48
1150 AD FD FF 00 28 60 4C 73
1158 00 00 AD FC FF 00 4A 90
1160 3A A2 00 00 86 0B A4 7A
1168 B9 00 00 02 38 FD 9B FF
1170 00 F0 13 C9 80 F0 13 E6
1178 0B E8 BD 9A FF 00 10 FA
1180 BD 9B FF 00 D0 E4 F0 C6
1188 E8 C8 D0 E0 84 7A A5 0B
1190 0A AA BD E3 FF 00 48 BD
1198 E2 FF 00 48 20 7B FC 00
11A0 4C 73 00 00 68 68 20 7B
11A8 FC 00 20 6B C9 4C 9F C4
11B0 A0 02 A5 2D D0 02 C6 2E
11B8 C6 2D 88 D0 F5 A5 2D 85
11C0 FB A5 2E 85 FC 4C 7B FD
11C8 00 20 29 FF 00 A9 24 8D
11D0 3C 03 A2 3C A0 03 A9 01
11D8 20 BD FF A9 0E A0 60 A2
11E0 08 20 BA FF 20 C0 FF A9
11E8 08 20 B4 FF A9 60 20 96
11F0 FF A9 00 00 85 90 A0 03
11F8 8C 3C 03 20 A5 FF 85 FD
1200 A4 90 D0 39 20 A5 FF 85
1208 FE A4 90 D0 30 AC 3C 03
1210 88 D0 E5 A6 FD A5 FE 20
1218 CD DD 20 78 FF 00 20 A5
1220 FF A6 90 D0 19 C9 00 00
1228 F0 0E 20 D2 FF 20 E1 FF
1230 F0 0D 20 66 FF 00 4C 42
1238 FD 00 20 75 FF 00 A0 02
1240 D0 BB A9 0E 20 C3 FF 20
1248 CC FF 4C 74 C4 20 2C FF
1250 00 4C 74 C4 A5 2B 85 FB
1258 A5 2C 85 FC 20 ED FE 00
1260 20 D8 FE 00 A9 00 00 A6
1268 FB A4 FC 20 D5 FF 20 33
1270 C5 A5 22 A6 23 18 69 02
1278 85 2D 90 01 E8 86 2E 20
1280 59 C6 4C B8 FD 00 20 ED
1288 FE 00 20 D8 FE 00 A5 2B
1290 85 FB A5 2C 85 FC A9 FB
1298 A6 2D A4 2E 20 D8 FF 20
12A0 24 FF 00 20 92 FE 00 4C
12A8 74 C4 20 39 FF 00 20 EF
12B0 FE 00 20 73 00 00 C9 2C
12B8 D0 2D 9D 3C 03 E8 20 73
12C0 00 00 C9 49 D0 22 20 73
12C8 00 00 F0 1D 9D 3C 03 E8
12D0 20 73 00 00 F0 14 9D 3C
12D8 03 E8 20 73 00 00 D0 0B
12E0 9D 3C 03 20 4E FF 00 D0
12E8 09 4C 71 FE 00 4C 08 CF
12F0 20 29 FF 00 4C 74 C4 20
12F8 22 FD A2 04 4C 41 FC 00
1300 20 3C FF 00 20 79 00 00
1308 F0 E7 C9 22 D0 E3 A5 7A
1310 85 FB A5 7B 85 FC 20 73
1318 00 00 F0 D6 C9 22 D0 F7
1320 20 73 00 00 C9 54 D0 CB
1328 20 73 00 00 C9 4F D0 C4
1330 20 73 00 00 20 EF FE 00
1338 A9 3D 9D 3C 03 E8 A5 FB
1340 85 7A A5 FC 85 7B 20 EF
1348 FE 00 A9 00 00 9D 3C 03
1350 4C 71 FE 00 20 3F FF 00
1358 20 EF FE 00 A9 00 00 9D
1360 3C 03 20 4E FF 00 D0 29
1368 4C 71 FE 00 20 ED FE 00
1370 A9 00 00 9D 3C 03 20 29
1378 FF 00 20 1A FF 00 A0 00
1380 00 B9 3C 03 F0 06 20 A8
1388 FF C8 90 F5 20 AE FF 20
1390 92 FE 00 F0 03 20 92 FE
1398 00 4C 74 C4 A9 08 85 BA
13A0 20 B4 FF A9 6F 20 96 FF
13A8 A0 00 00 20 A5 FF 99 3C
13B0 03 C8 C9 0D D0 F5 A9 00
13B8 00 99 3C 03 20 AB FF A0
13C0 00 00 A9 30 D9 3C 03 D0
13C8 06 C8 D9 3C 03 F0 15 20
13D0 24 FF 00 20 CC FF 20 75
13D8 FF 00 A9 3C A0 03 20 1E
13E0 CB 68 68 4C 74 C4 60 20
13E8 29 FF 00 8A A2 3C A0 03
13F0 20 BD FF A9 08 AA A0 00
13F8 00 84 90 4C BA FF A2 00
1400 00 86 B7 20 79 00 00 F0
1408 1F C9 22 D0 1B E6 7A D0
1410 02 E6 7B A0 00 00 B1 7A
1418 F0 0A C9 22 F0 06 9D 3C
1420 03 E8 D0 EA E4 B7 F0 01
1428 60 68 68 4C 08 CF A9 08
1430 20 B1 FF A9 6F 4C 93 FF
1438 A9 08 4C C3 FF A9 49 2C
1440 A9 56 48 20 1A FF 00 68
1448 20 A8 FF 4C AE FF A9 4E
1450 2C A9 52 2C A9 53 A2 00
1458 00 9D 3C 03 E8 A9 3A 9D
1460 3C 03 E8 60 A2 00 00 BD
1468 7D FF 00 F0 06 20 42 E7
1470 E8 D0 F5 20 CF FF C9 59
1478 08 20 75 FF 00 28 60 20
1480 E4 FF F0 09 C9 20 D0 05
1488 20 E4 FF F0 FB 60 A9 0D
1490 2C A9 20 4C D2 FF 0D 41
1498 52 45 20 59 4F 55 20 53
14A0 55 52 45 3F 20 28 59 2F
14A8 4E 29 20 00 00 4C 52 FC
14B0 00 00 00 B0 0A C9 00 00
14B8 41 50 50 45 4E C4 43 41
14C0 54 41 4C 4F C7 43 4F 4C
14C8 4C 45 43 D4 44 4C 4F 41
14D0 C4 44 53 41 56 C5 48 45
14D8 41 44 45 D2 49 4E 49 D4
14E0 4B 49 4C CC 4F 46 C6 52
14E8 45 4E 41 4D C5 53 43 52
14F0 41 54 43 C8 53 45 4E C4
14F8 53 54 41 54 55 D3 00 00
1500 D7 FC 00 EF FC 00 6C FD
1508 00 72 FD 00 A0 FD 00 C0
1510 FD 00 FD FD 00 03 FE 00
1518 06 FE 00 0B FE 00 55 FE
1520 00 68 FE 00 8B FE 00 00
1528 00 00 00 00 00 00 00 AA
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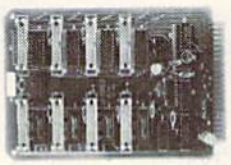
Circle 240 on Reader Service card.

FOR THE VIC-20*



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(from p. 114)

```
00577  1379  C5
00578  137A  48 45             .BYTE 'HEADE', $D2
00578  137F  D2
00579  1380  49 4E 49          .BYTE 'INI', $D4
00579  1383  D4
00580  1384  4B 49 4C          .BYTE 'KIL', $CC
00580  1387  CC
00581  1388  4F 46             .BYTE 'OF', $C6
00581  138A  C6
00582  138B  52 45             .BYTE 'RENAM', $C5
00582  1390  C5
00583  1391  53 43             .BYTE 'SCRATC', $C8
00583  1397  C8
00584  1398  53 45 4E          .BYTE 'SEN', $C4
00584  139B  C4
00585  139C  53 54             .BYTE 'STATU', $D3
00585  13A1  D3
00586  13A2  00                .BYTE $00       ;END OF KEYWORDS MARKER
00587  13A3                 ;
00588  13A3                 ;
00589  13A3                 ;*** ROUTINE ACTION ADDRESSES ***
00590  13A3                 ;
00591  13A3                 ;
00592  13A3  98 10          ACTION .WORD APPEND-1
00593  13A5  B0 10                 .WORD CAT-1
00594  13A7  2D 11                 .WORD COLLEC-1
00595  13A9  33 11                 .WORD DLOAD-1
00596  13AB  61 11                 .WORD DSAVE-1
00597  13AD  81 11                 .WORD HEADER-1
00598  13AF  BE 11                 .WORD INIT-1
00599  13B1  C4 11                 .WORD KILL-1
00600  13B3  C7 11                 .WORD OFF-1
00601  13B5  CC 11                 .WORD RENAME-1
00602  13B7  16 12                 .WORD SCRATC-1
00603  13B9  29 12                 .WORD SEND-1
00604  13BB  4C 12                 .WORD STATUS-1
00605  13BD                 ;
00606  13BD                 ;
00607  13BD                 ;DISK-O-VIC VARIABLES
00608  13BD                 ;
00609  13BD                 ;
00610  13BD  00             SSAVE  .BYTE $00       ;STATUS REGISTER SAVE.
00611  13BE  00             ASAVE  .BYTE $00       ;ACCUMULATOR SAVE.
00612  13BF  00             XSAVE  .BYTE $00       ;X REGISTER SAVE.
00613  13C0  00             YSAVE  .BYTE $00       ;Y REGISTER SAVE.
00614  13C1                        .END
```

(from p. 112)

screen a string aimed at by the accumulator and y register. It will keep printing the string of characters until a terminating zero is detected.

To learn more about the operation of the VIC-20, be sure to carefully examine the table of equates in Listing 1. In most cases, the locations and routines have been given meaningful labels to aid interpretation, and the comments will fill in some of the details. For more information on the Kernal routines, refer to the *VIC-20 Programmer's Reference Guide* (Howard W. Sams and Co., PO Box 7092, Indianapolis, IN 46206). To understand the non-Kernal routines, you will need a more extensive memory map.

Entering the Program

Having covered the theory and operation of DISK-O-VIC, we must consider the practical side of things. You should create a disk copy of the object code so that the utility is always handy. To this end, the hexdump in Listing 2 corresponds to the source code in Listing 1. To use it, you enter the hexadecimal numbers into the VIC-20, then save it to disk. Thus, whenever you want to invoke DISK-O-VIC, you have only to load the code and initialize it.

Since the program is in machine language, you will need a machine language monitor to enter it. The VIC-20 has no resident monitor, but add-on monitors are starting to appear with increasing frequency. Two good choices are VICmon or Tinymon.

VICmon, made by Commodore, is the official machine language monitor for the VIC-20 and offers many commands. It comes in cartridge (ROM) form, and simply slips into the expansion port. Tinymon, on the other hand, is a tape or disk-loaded monitor. The advantage of Tinymon is that you can punch it in yourself and save quite a bit of money. It doesn't support as many commands as VICmon, but that doesn't matter for the purpose at hand. All you need are the S (save) and M (memory dump) commands. Hence, either monitor will do.

(For a full discussion of Tinymon, see Jim Butterfield's article "Tinymon1: A Simple Monitor for the VIC," in the January 1982 issue of *COMPUTE!*, p. 176.)

To make a copy of DISK-O-VIC for your computer, follow these instructions carefully:

- Disconnect any memory add-ons. DISK-O-VIC must be entered on a stock machine.
- Load in a machine language monitor. Either tape/disk-based or cartridge monitors will do.
- Using Listing 2 as a guide, punch in the object code. You will start entering code at location $1000 and continue upward.
- After you finish entering the code, modify the following locations. Put the data byte $2F into locations $2D, $2F and $31. Put the data byte $15 into locations $2E, $30 and $32. These are all zero-page locations.
- Exit the monitor to Basic with the X command.
- Now save the program using the ordinary VIC-20 SAVE command. You may save the program to either tape or disk.
- If you wish, reconnect any memory add-ons that you have.

You now have a full version of DISK-O-VIC ready to go. The code just entered and saved is very special. You can load and run it just like any Basic program. When you run the program, a special loader automatically relocates DISK-O-VIC to the top of memory, wherever that might be. Also, the loader instantly compensates for any extra memory that might be attached to the VIC-20.

Keypunching this program can be very tedious, so try to share the task with other users. One consolation is that even though the program is in machine language, it looks like Basic to the VIC-20. This means that you can make backup copies quite easily. To do so, simply load DISK-O-VIC (don't run it) and save some more copies by using the ordinary Save command.

Conclusion

The practical value of DISK-O-VIC should be obvious, but the program should also serve as an example of how a complete disk operating system can be implemented on the VIC-20. The computer clearly contains many powerful routines in ROM, and it behooves every user to learn as much as possible about them. The program also shows that the 1541 disk drive is an extremely flexible unit.

Programming the VIC-20 and 1541 in machine language to perform new and exotic commands is not as difficult as it may at first seem. The key, of course, is to break the problem down into a series of smaller subroutines, making as much use as possible of the various ROM routines available. This was the very procedure used in DISK-O-VIC. R

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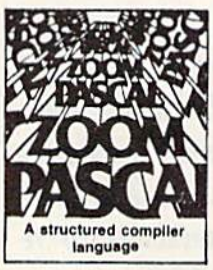

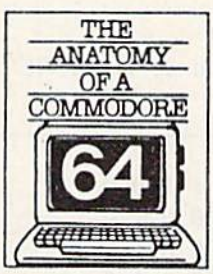

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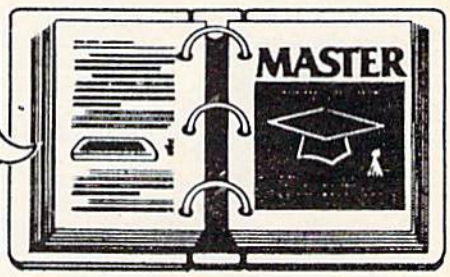

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Game programs are not the only beneficiaries of VIC's graphics ability. Mathematicians, foreign language students and musicians can use it to create characters specific to their fields. Symbols such as Σ (sigma), λ (lambda), Ω (ohm), ~ (tilde), ¨ (umlaut), ♩ (quarter note) and 𝄞 (treble clef) can be created and put to use by programmers who formerly could not express themselves with the VIC's limited keys.

Listing 1 provides an "electronic worksheet" you can experiment with to create your own characters. But before we discuss the programs some explanation must be given about the nature of the VIC's characters and screen.

Pixelated Characters

Each character you see on the VIC's screen is actually made up of 64 tiny units called pixels. This goes for every character, from the letter A to an inversed graphics symbol. Every character is eight pixels wide and eight pixels high. These points may be either on (light) or off (dark). The placement of the darkened pixels in relation to the light ones gives the illusion of the entire character.

```
0 0 1 1 1 1 0 0
0 1 0 0 0 0 1 0
0 1 0 0 0 0 1 0
0 1 0 0 0 0 1 0
0 1 0 0 0 0 1 0
0 0 1 0 0 1 0 0
1 1 0 0 0 0 1 1
0 0 0 0 0 0 0 0
```

Fig. 1a. Binary representation of the ohm character.

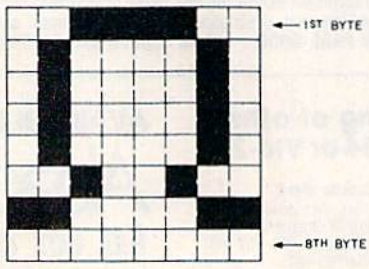

Fig. 1b. Pixel representation of the ohm character.

The VIC's memory has a special way of controlling characters and knowing which pixels are on or off. This is known as bit-mapping, in which each pixel is represented by a specific bit in memory.

You may already know that all information stored in the computer is in its most basic form, the binary language. Binary numbers are composed only of the binary digits (bits) 1 and 0. This system is the simplest form of communication; a numeric representation of on and off; yes and no; dark and light. Bits are grouped into units of eight, called bytes, in the computer's memory locations. The amount of memory your computer has is given in K for kilobytes (1K equals 1024 bytes, or 8192 bits), representing the amount of information it can hold.

Bits play a vital role in the creation of symbols on the VIC. Since bits can be set on or off, they are used directly in the VIC's memory to represent each pixel's status. Because each memory location stores one byte, an entire row of eight pixels may be stored in a memory location as a binary number. Eight of these locations, then, are required to hold the bytes for an entire character.

Fig. 1 is a graphic illustration of the character Ω (ohm). The ohm symbol is not a standard character on the VIC, but we will use it as an example of how to design a custom character.

Character Building

You can make the actual design of the character on a piece of graph paper, or you may use the Prograf electronic

Σχόλιο

Listing 1. Prograf electronic worksheet program.

```
1 PRINT "[SHFT CLR]"
2 PRINT"[CTRL 1]"
10 POKE 52,28:POKE 56,28:CLR
15 FOR A=7168 TO 7680:POKE A,PEEK(A+25600):NEXT
19 POKE 36869,255
20 FOR A=7384 TO 7391: READ B:POKE A,B:NEXT
25 DATA 0,0,0,0,0,0,0,0
30 FOR A=7392 TO 7399: READ C:POKE A,C:NEXT
35 DATA 255,255,255,255,255,255,255,255
100 FOR G=7753 TO 7759:READ H:POKE G,H:NEXT
105 DATA 16,18,15,7,18,1,6
110 FOR G=38473 TO 38479:READ H:POKE G,H:NEXT
115 DATA 6,6,6,0,0,0,0
116 FOR G=7456 TO 7463:READ H:POKE G,H:NEXT
117 DATA 255,0,0,0,0,0,0,0
118 FOR G=7464 TO 7471:READ H:POKE G,H:NEXT
119 DATA 255,128,128,128,128,128,128,128
120 PRINT SPC(99);"[CTRL 1][UP ARROW]=DARK"
121 FOR G=7472 TO 7479:READ H:POKE G,H:NEXT
122 DATA 128,128,128,128,128,128,128,128
125 PRINT TAB(5);CHR$(38);TAB(12);"[CTRL 1]]=LIGHT"
130 FOR J=1 TO 8
135 FOR G=1 TO 8
140 PRINT TAB(1) CHR$(37);
145 NEXT G
146 PRINT CHR$(38)
150 NEXT J
155 FOR G=1 TO 4
160 PRINT TAB(1) CHR$(36);
165 NEXT G
170 PRINT TAB(5) CHR$(37);
175 FOR G=1 TO 2
180 PRINT TAB(6) CHR$(36);
185 NEXT G
186 PRINT TAB(8) CHR$(36)
190 PRINT
195 FOR G=7400 TO 7407:READ V:POKE G,V:NEXT
200 DATA 28,16,16,16,16,16,16,28
205 FOR G=7408 TO 7415:READ W:POKE G,W:NEXT
210 DATA 8,20,16,16,56,16,16,82
255 PRINT"DO ONE ROW AT A TIME"
260 FOR G=1 TO 4000:NEXT
265 PRINT"START WITH TOP ROW"
270 FOR G=1 TO 4000:NEXT
271 FOR G=8076 TO 8163:POKE G,32:NEXT
275 INPUT"[CRSR UP][CRSR UP]1ST ROW";A$
278 I=0
279 X$=A$
280 GOSUB 495
285 I=A+B+C+D+E+F+G+H
290 PRINT "[CRSR UP][CRSR UP][CRSR UP][CRSR UP
    ][CRSR UP][CRSR UP][CRSR UP][CRSR UP][CRS
    R UP][CRSR RT]";A$
295 FOR Z=8032 TO 8119:POKE Z,32:NEXT
300 INPUT "[CRSR DN][CRSR DN][CRSR DN][CRSR DN
    ][CRSR DN][CRSR DN][CRSR DN][CRSR DN]2ND
    ROW";B$
304 X$=B$
305 GOSUB 495
310 J=A+B+C+D+E+F+G+H
315 PRINT "[CRSR UP][CRSR UP][CRSR UP][CRSR UP
    ][CRSR UP][CRSR UP][CRSR UP][CRSR UP][CRS
    R UP][CRSR RT]";B$
320 FOR Z=8076 TO 8119:POKE Z,32:NEXT
325 INPUT  "[CRSR DN][CRSR DN][CRSR DN][CRSR D
    N][CRSR DN][CRSR DN][CRSR DN][CRSR DN]3RD ROW";C$
330 X$=C$
335 GOSUB 495
340 K=A+B+C+D+E+F+G+H
345 PRINT "[CRSR UP][CRSR UP][CRSR UP][CRSR UP
    ][CRSR UP][CRSR UP][CRSR UP][CRSR UP][CRS
    R RT]";C$
```

More

worksheet program (Listing 1). With Prograf, you can manipulate and develop characters and see immediately what they will look like on the screen. Whichever method is used, the translation of a design into binary is made by writing a zero for any blank space and a one for a darkened one. If the reversed graphic form of a character is desired, simply do the opposite of this and place a one for any blank space and a zero for any darkened one.

With the VIC, you cannot input character information directly in binary form, but rather in its decimal equivalent. Since it is not a common skill to be able to rattle off binary numbers and their decimal counterparts, Fig. 2 is given to make this conversion easier.

One method to calculate the decimal equivalent of binary character information is given in the VIC-20 *Programmer's Reference Guide*. This method requires you to add together eight separate numbers—one for each pixel column. The value of each column is the number 2 raised to the power of that column number (numbered from 7 to 0, left to right). This method is cumbersome to use and creates more work than is necessary.

The alternative method in Fig. 2 shows all of the possible placement combinations for four pixels. The chart gives the decimal equivalents of the rightmost and leftmost four pixels. Using this system, you add together the

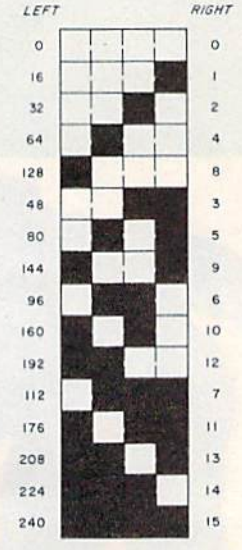

Fig. 2. The possible placement combinations for four pixels. The right-hand value (for the four pixels to the right) plus the left-hand value (for the four pixels to the left) equals the data value for the whole byte.

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Listing 1 continued.

```
350 FOR Z=8076 TO 8119:POKE Z,32:NEXT
355 INPUT "[CRSR DN][CRSR DN][CRSR DN][CRSR DN][CRSR DN
    ][CRSR DN][CRSR DN][CRSR DN]4TH ROW";D$
358 X$=D$
359 GOSUB 495
360 L=A+B+C+D+E+F+G+H
361 PRINT "[CRSR UP][CRSR UP][CRSR UP][CRSR UP][CRSR UP
    ][CRSR UP][CRSR UP][CRSR UP][CRSR RT]";D$
362 FOR Z=8076 TO 8119:POKE Z,32:NEXT
365 INPUT "[CRSR DN][CRSR DN][CRSR DN][CRSR DN][CRSR DN
    ][CRSR DN][CRSR DN]5TH ROW";E$
366 X$=E$
368 GOSUB 495
369 M=A+B+C+D+E+F+G+H
370 PRINT "[CRSR UP][CRSR UP][CRSR UP][CRSR UP][CRSR UP
    ][CRSR UP][CRSR UP][CRSR UP][CRSR RT]";E$
372 FOR Z=8076 TO 8119:POKE Z,32:NEXT
374 INPUT "[CRSR DN][CRSR DN][CRSR DN][CRSR DN][CRSR DN
    ][CRSR DN]6TH ROW";F$
375 X$=F$
376 GOSUB 495
377 N=A+B+C+D+E+F+G+H
378 PRINT "[CRSR UP][CRSR UP][CRSR UP][CRSR UP][CRSR UP
    ][CRSR UP][CRSR UP][CRSR RT]";F$
379 FOR Z=8076 TO 8119:POKE Z,32:NEXT
380 INPUT "[CRSR DN][CRSR DN][CRSR DN][CRSR DN][CRSR DN
    ]7TH ROW";G$
381 X$=G$
382 GOSUB 495
383 O=A+B+C+D+E+F+G+H
384 PRINT "[CRSR UP][CRSR UP][CRSR UP][CRSR UP][CRSR UP
    ][CRSR UP][CRSR RT]";G$
385 FOR Z=8076 TO 8119:POKE Z,32:NEXT
386 INPUT "[CRSR DN][CRSR DN][CRSR DN][CRSR DN]8TH ROW"
    ;H$
387 X$=H$
388 GOSUB 495
389 P=A+B+C+D+E+F+G+H
390 PRINT "[CRSR UP][CRSR UP][CRSR UP][CRSR UP][CRSR UP
    ][CRSR RT]";H$
391 FOR Z=8076 TO 8119:POKE Z,32:NEXT
395 PRINT"[CRSR DN]DATA";I;J;K;L;M;N;O;P
400 POKE 7416,I:POKE 7417,J:POKE 7418,K:POKE 7419,L:POK
    E 7420,M:POKE 7421,N
401 POKE7422,O:POKE 7423,P
405 PRINT"[CRSR UP][CRSR UP][CRSR UP][CRSR UP][CRSR UP]
    [CRSR UP][CRSR UP][CRSR UP][CRSR UP][CRSR UP]"TAB(
    14);CHR$(95)
415 PRINT"[CRSR DN]";TAB(12);"CHOOSE: ",TAB(12);"1=MODI
    FY",TAB(12);"2=ANOTHER",TAB(12);
418 PRINT"3=END"
420 GET Z$:IFZ$="" THEN 420
422 IF Z$>"3" OR Z$<"1" THEN 420
425 IF Z$="1" THEN 435
427 IF Z$="2" THEN 1
430 IF Z$="3" THEN 450
435 FOR Z=8054 TO 8163:POKE Z,32:NEXT
436 CLR
437 INPUT"[CRSR DN][CRSR DN]1ST ROW";A$
438 GOTO 278
450 PRINT"[SHFT CLR]"
451 POKE 646,88
452 PRINT SPC(117)"THE END"
455 END
495 A=0:B=0:C=0:D=0:E=0:F=0:G=0:H=0
500 IF MID$(X$,1,1)=CHR$(92) THEN A=128
501 IF MID$(X$,2,1)=CHR$(92) THEN B=64
502 IF MID$(X$,3,1)=CHR$(92) THEN C=32
503 IF MID$(X$,4,1)=CHR$(92) THEN D=16
504 IF MID$(X$,5,1)=CHR$(92) THEN E=8
505 IF MID$(X$,6,1)=CHR$(92) THEN F=4
506 IF MID$(X$,7,1)=CHR$(92) THEN G=2
507 IF MID$(X$,8,1)=CHR$(92) THEN H=1
508 RETURN
```

decimal values which correspond to the rightmost and leftmost four pixels of a character row.

Taking our ohm character as an example, you get the decimal value of the first byte by first looking up the value of the right bits (■■□□), 12, and adding it to the value of the left bits (□□■■), 48. In the formula R+L=P, the right value, R, plus the left value, L, equals the decimal value, P, for the entire row. Substituting the appropriate chart value, 12+48=60, the value of row 1.

In row 2, then, 2+64=66. Rows 3 through 5 have the same value as row 2, because their bit patterns are identical. The 6th row has the decimal value of 36 (4+32). Row 7's value is 195 and row 8 has the value 0. Each of the decimal numbers obtained by this process may now be Poked into the VIC's memory, thus providing the information necessary to print the ohm character on the screen.

Memory Space

Before you make any attempt to store a character, though, you must prepare a place in memory to hold this information. The character set in use when the VIC is first turned on is stored in the character generator ROM. A second set, achieved by pressing the shift and Commodore keys simultaneously, is also stored in this ROM. Because of the very nature of Read Only Memory, no custom characters may be put into it. The RAM area, however, is completely available for your use.

There are two locations in RAM that act as pointers to tell the computer where to get its character information. You may alter these two locations to point to an area in the unexpanded VIC's RAM. You can then place any characters into RAM, and the VIC will be able to access them.

One problem occurs when the character pointers are changed to point to RAM: the ability to utilize the VIC's pre-programmed character set is forfeited. But this is not as troublesome as it might seem. A few short program lines are all you need to program a section of RAM with the character information from ROM.

```
FOR X=7168 TO 7679
POKE X, PEEK (X+25600)
NEXT X
```

Addresses in the RAM to which character information is being transferred are represented by X. In this example, the top .5K of RAM is being utilized (7168 to 7679). You may access more or less of this area by using higher or lower

values for X and changing 25600 to a number which, when added to the first value of X, equals 32768 (7168+25600 =32768), the beginning of character ROM. The second line of the program Peeks the character information from the ROM and Pokes it into the RAM location set by X.

Once the character set has been moved to RAM, an alarming event occurs. The cursor disappears from the screen, making it difficult to do any editing of program listings. This does not affect your ability to do the actual editing, but your sense of where the cursor is will be impaired. If you know the cursor is located directly under the R in the "READY." that appears on the screen after an action is completed, you can count the number of cursor movements required to get to a certain space.

You must choose the placement of the character set in RAM very carefully. Expansion RAM must not be used for this purpose, because the VIC chip pointers have no access to this area. Two other areas which should not be used for storage of the character set begin at 0 (data for the computer's use of Basic is stored here) and at 4096 (this is the beginning of Basic program storage).

The upper portion of the area in RAM where Basic programs are stored (4096–7679) is the best location for the characters. Because you need to save some of this room for the Basic program that utilizes the characters, only the top .5K of this area will be used for the character set in our example.

The 3.5K of the VIC's Basic program storage area is filled up from several areas within this region at once. Variables, arrays, strings and the Basic program itself are all written into memory locations beginning at different addresses within this area. Basic program instructions are written from the bottom, 4096, upward. Any data that is being stored in strings is written into memory from the top, 7679, downward to 7657.

The beginning and ending points of variable and array information are dependent on where the Basic program

Starting location for character set	Poke 52 and 56 with values...	Poke 36869 with values...	Memory allocated for character set
5120	20	253	2.5K
6144	24	254	1.5K
7168	28	255	.5K

Fig. 3. Addresses in RAM allowing larger character sets. Poke the specified locations with the appropriate values to begin your character set at the RAM location in column one. (Note: these values are for the unexpanded *VIC-20.)*

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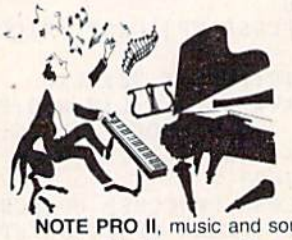
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ends. If you were to place the character set into RAM 7168–7679, and if strings were used in a program, the character information would be written over with the string data and lost for good. It is easy to see the importance of protecting the character set after you have moved it to the fragile RAM.

Just like the pointers which access character information, there are pointers that tell the VIC where to begin writing programs and string data. These string pointers can be set to point to a location below the character set, leaving character information safe from being written over. Fig. 3 provides a listing of places in RAM where the pointers may be set in order to encompass an even larger character set.

Custom Characters

To demonstrate these ideas, let's program our ohm character. The data which we calculated earlier in this article will be put into the RAM locations 7168 to 7175. This area contains the information for the @ symbol when the character set is first moved.

```
5 POKE 52, 28: POKE 56, 28: CLR
10 FOR X=7168 TO 7679: POKE X, PEEK
   (X+25600): NEXT X
15 POKE 36869,255
20 FOR L=7168 TO 7175: READ D: POKE
   L,D: NEXT L
25 DATA 60, 66, 66, 66, 66, 36, 195, 0
```

Lines 5–15 reserve memory, change the character pointers and move the character set. Alteration of the @ symbol into the ohm (Ω) symbol occurs in lines 20 and 25.

By changing the location numbers in line 20 and using data for different characters in line 25, the entire character set can be reprogrammed to contain any shapes, symbols or characters desired. Even with a key's appearance changed, this key retains its original definition. A plus sign (+) still adds numbers together despite a new appearance.

You must first know the beginning and ending locations of a character in RAM before the character can be altered. In order to do this, you must first obtain the character's screen code from the VIC's user guide (*Personal Computing on the VIC-20*, pp. 141 and 142). Multiply this number by eight and add the result to the number representing the starting location of the character set in RAM to find the beginning address. Then add seven to that number to obtain the ending address.

Hi-Res

The use of high-resolution graphics makes for the sharpest, most professional-looking screen displays. It also saps the most memory. We stated in the custom-character discussion that the smallest area that can be manipulated on the VIC's screen is one pixel, which is 1/64 the size of an entire character. In using high-resolution graphics, you must control the individual pixels of each character, and to do so the screen must be bit-mapped as mentioned above.

The VIC's screen is 22 characters wide and 23 long. This means that the full VIC screen has a resolution of 176×184 pixels, for a total of 32,384. When each pixel is designated to an individual bit, a total of 4048 bytes is required to store them. Obviously, this is not possible on the unexpanded VIC. However, it is possible to bit-map a portion of the VIC's screen. An area of 8×8 characters (64×64 pixels) would require only 512 bytes of memory to store its information, and this is within memory capacity.

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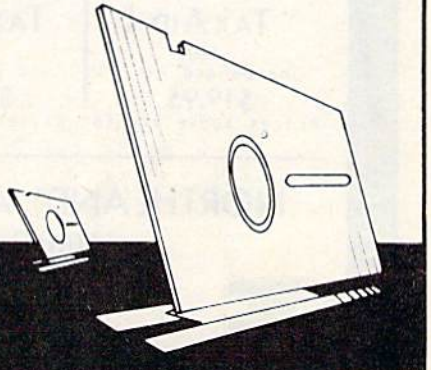

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For this example, we want to combine programmable characters and high-resolution graphics. All the steps outlined above for defining characters will be used here, in addition to the procedures required to prepare the screen for high-resolution graphics. The first step is to clear out a portion of screen memory to use for bit-mapping. Screen memory is located directly above the Basic program storage area, from 7680 to 8191. In order to clear this area of random bits that are stored there, use the command

```
FOR S=7168 TO 7679: POKE S,0: NEXT S
```

This Pokes zero bits into the screen memory locations 7168 and 7679. A quick examination of the memory address values indicates a difference of 512. This total corresponds to the 512 bytes we have allocated for the high-resolution screen.

A high-resolution program requires several formulas to locate and control individual pixels. An analogy is writing a letter to a friend. You must have several ways of addressing that person—each more specific than the last. You must know the country, state, city, zip code, street address and, finally, the friend's name.

Locating a specific pixel is carried out with equal precision. The character in which the pixel "resides" is the largest unit in which it can be found, like the country of your friend. This formula calculates the character's display code within the 8×8 character grid:

```
C=INT(X/8)*8 + INT(Y/8)
```

C stands for the character's display code number, and X and Y are the horizontal and vertical coordinates of the pixel that is to be changed.

The pixel's row within the character is calculated by the formula

```
R=(Y/8-INT(Y/8))*8
```

Variable R is the row number, and Y, again, is the vertical coordinate.

To calculate the byte number, or address in which the pixel's binary digit exists, you multiply the character's number (C) by eight and add the result to the row number (R) and 7168, the beginning of screen memory. (This screen memory number will be different if you are using anything other than the top .5K of RAM for character storage.) The variable T represents the byte number.

```
T=7168+8*C+R
```

Finally, you find the bit's number by using the formula

```
I=7-(X-INT(X/8)*8)
```

The bit number is represented by I, and the horizontal and vertical coordinates are X and Y, respectively.

Hi-Res Applications

An ideal use for high-resolution pixel control is to provide visualization of mathematical equations. A formula for a line or curve could be given in the program and its X and Y values converted by the four pixel-control formulas into the appropriate terms to cause the line or curve to appear on the high-resolution screen.

In a similar way, other formulas could be used to control game characters. When this pixel-manipulation ability is combined on the high-resolution screen with characters that are custom-designed for the programmer's needs, the possibilities are almost limitless.

Multi-Colored Characters

The VIC is a many-splendored thing! Normal characters (as well as user-programmed ones) are made up of two colors: the character's specifically chosen color as entered with the control and color keys, and the screen color. However, the VIC has a special mode that allows four separate colors to be contained within a single character. In the unexpanded VIC, this mode may be entered simply by Poking the color control register (646).

This register's value is altered any time a character color is changed with the control and color keys. Poking this register with a number from zero to seven gives the character a color from black to yellow, throughout the VIC's entire color spectrum.

The four colors composing each character in multi-color mode are the current screen, border and character colors, as well as an auxiliary color which is dependent on the number Poked into the color register. Resolution in multi-color mode is half of what it is in regular mode. This is because multi-color mode pixels are controlled in pairs.

The order of the two bits in each pair decides its color. If the pair consists of two zero bits (00), those two corresponding pixels will be screen colored. If the order of the bits is 01, the border color will fill in that area of the screen. 10 prints the character color in the appropriate places, and 11 draws the auxiliary color. If we placed our ohm character on the screen in multi-color mode,

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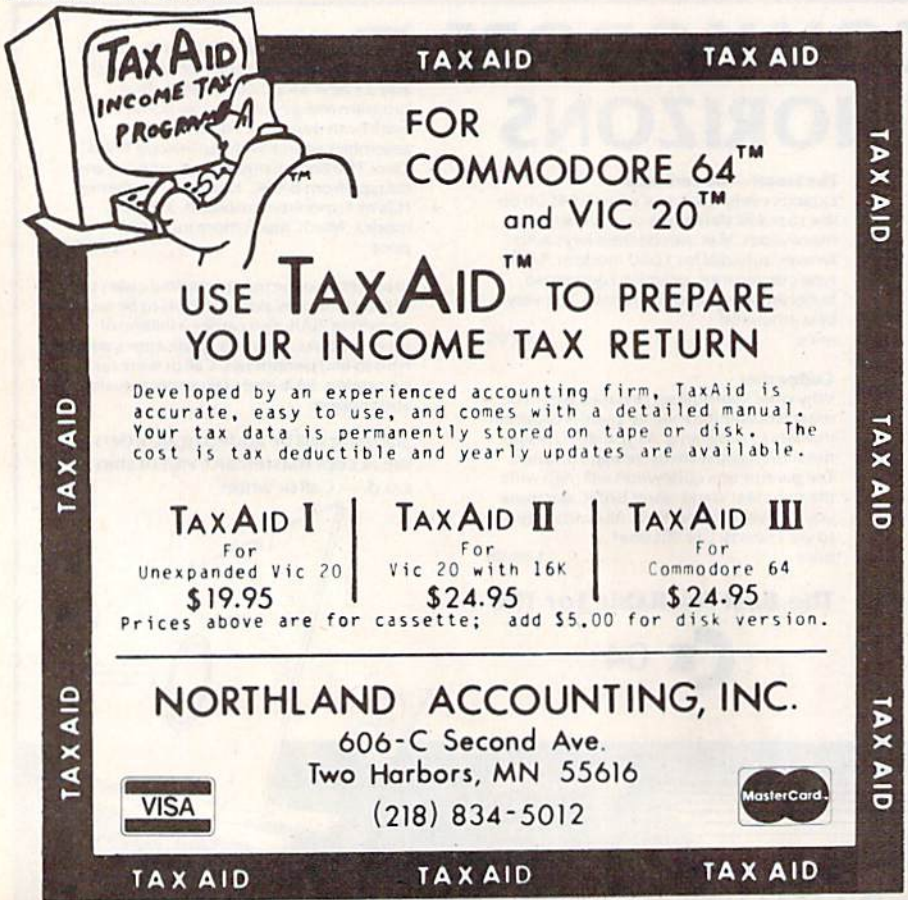
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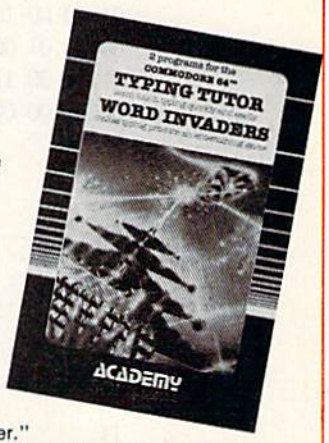

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(a)

```
00 11 11 00
01 00 00 10
01 00 00 10
01 00 00 10
01 00 00 10
00 10 01 00
11 00 00 11
00 00 00 00
```

(b)

```
SS AA AA SS
BB SS SS CC
BB SS SS CC
BB SS SS CC
BB SS SS CC
SS CC BB SS
AA SS SS AA
SS SS SS SS
```

(c)

Bit pairs	Color assignment	Color
00	SS	screen
01	BB	border
10	CC	character
11	AA	auxiliary

Fig. 4.(a) Binary representation of ohm character in bit pairs. (b) Screen representation of ohm character in multi-color mode. (c) Assignment of colors to the ohm character in multi-color mode.

the color placement would be chosen as shown in Fig. 4.

Using multi-color mode, characters are distorted almost beyond recognition. However, keeping in mind the color each pair stands for, it would be possible to create a custom character made up of colors rather than a specific shape. The bits required to make a four-color checkerboard are shown in Fig. 5.

It is possible to utilize multi-color graphics within a program by simply adding a line which Pokes location 646. However, doing this will cause everything printed on the screen thereafter to be multi-colored. More control may be exercised over this mode by setting only certain spaces to be multi-colored. The formula

```
H=37888+4*(PEEK(36866) AND 128)
```

finds the location of color memory. Location 36878 is then Poked to set the auxiliary color. Poking H with an auxiliary color sets the space at the upper left-hand corner of the screen to multi-color mode. Adding 1 to H and Poking the result with an auxiliary color makes the next space to the right multi-colored, and so on.

The placement of areas on the screen that will be set to this mode is chosen according to its use in a program. Perhaps a certain area of the screen in a game program is a hidden bonus zone. When a character moves into this area, it appears multi-colored, and a player will know that bonus points have been awarded.

Equipped with the knowledge of the VIC's true graphics capabilities and the skills required to use them, you may find uses for the VIC other than list keeping. The sluggish VIC graphics can metamorphose into hi-res displays in only a few program lines.

The Prograf Program

Prograf is a reusable, non-wasteful electronic graph-paper pad. A selection between two keys will either darken (£) or lighten ([) a pixel. Each of the eight rows that make up a programmable character are colored separately. After all eight of the rows have been completed, an actual-size rendition of the programmed character is displayed.

Also, a corresponding Data statement is listed, with all of the information necessary for the reproduction of the new character. Finally, a menu provides a choice of modifying the existing character, constructing a totally new character or terminating the program.

Prograf is divided into several distinct sections. This enables the novice programmer to easily follow the construction of Prograf, but does not inhibit its function or decrease its utility. Lines 10–19 move 64 members of the character set into a reserved area of the memory. Instead of being printed, the main title is Poked onto the screen and is then colored (lines 100–115).

Character numbers 92 and 91 were chosen to represent an "on" bit (£) and an "off" bit ([). Two other characters (CHR$94 and CHR$93) were then necessary to represent the former likenesses of these keys so that they could be displayed in a menu. The eight-row grid is printed in lines 130–190 along with a menu for the dark and light keys (lines 120 and 125).

In order to make the construction of the grid easier, three other characters were custom-defined (lines 116–122). The prompting for each line and its subsequent printing are in lines 275–390. A Data statement, the newly formed character and a menu are then printed on the screen (lines 395–415).

Because the menu is driven by a Get statement, the Data information will remain on the display until a selection is made from the menu. A choice of "modify" goes to lines 435–438 for erasing the Data material and clearing the memory of variables. Lines 450–455 are for ending the program in the bizarre multi-color mode. Lastly, all of the calculations for the printed Data listings are performed in the Gosub, lines 495–508.

If properly used, Prograf can be a powerful, time-saving programming tool. It was intended for home use by careful programmers, so no safety provisions have been added. Granted, the menu's Get statement is well protected against erroneous entries, but the rest of the program is not. Therefore, pressing the wrong key, entering too many pixels or failing to enter a completed row will cause a Prograf crash.

Complete recovery is *sometimes* possible by simultaneously pressing Run/Stop and Restore. However, if problems continue to appear, recheck your program listing for errors.

If you'd like to avoid the tedium of typing in Prograf, the authors will send you a fully documented cassette tape for $5. R

Bits	Color Assignment
00 00 10 10	SS SS CC CC
00 00 10 10	SS SS CC CC
00 00 10 10	SS SS CC CC
00 00 10 10	SS SS CC CC
01 01 11 11	BB BB AA AA
01 01 11 11	BB BB AA AA
01 01 11 11	BB BB AA AA
01 01 11 11	BB BB AA AA

Fig. 5. Bit-ordering required to create a four-color checkerboard in multi-color mode. See Fig. 4c for an explanation of color assignments.

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Sea Battle

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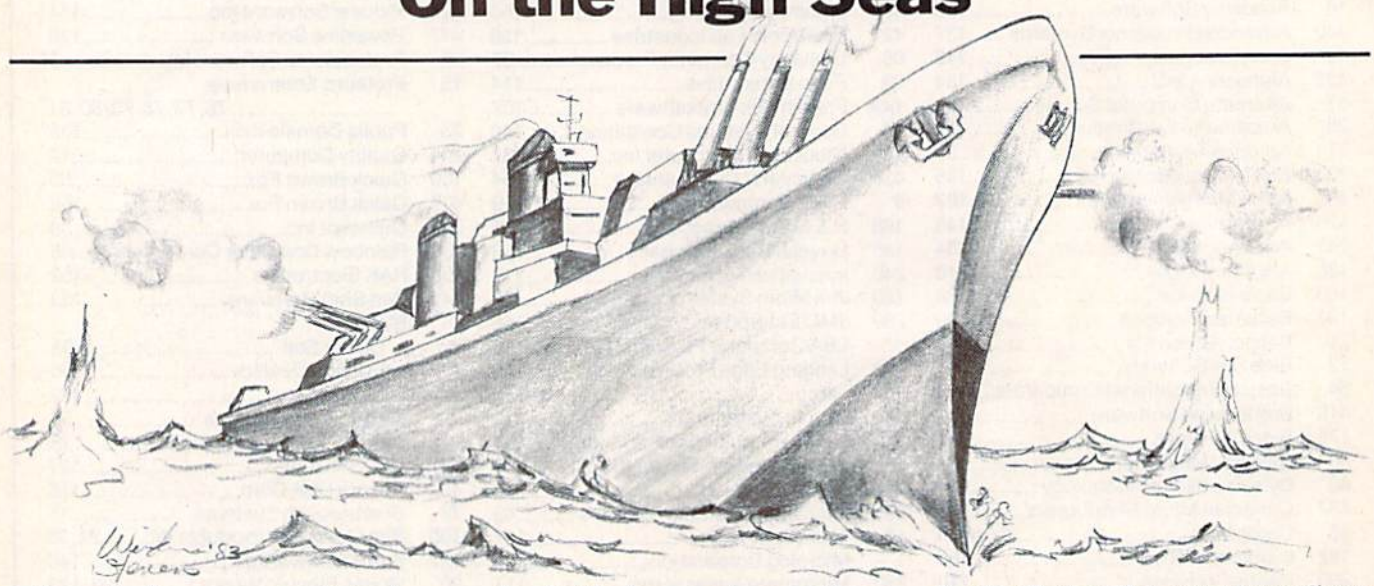

If you're keen on naval strategy or simply want to improve your aim, try navigating this seaworthy game.

By David Gardner

Sea Battle, for one player on the unexpanded VIC-20, is based on the popular board game, Battleship. The object is to sink the computer's ships before it sinks yours.

You and the computer each have five ships, placed on grids at the beginning of the game. The names of the ships and the number of hits required for sinking them are as follows:

- Carrier 5 hits
- Battleship 4 hits
- Cruiser 3 hits
- Submarine 3 hits
- Destroyer 2 hits

At the start of play you'll be asked to choose a skill level from one to three. On the first level, you and the computer trade shots one for one. On the second, the computer fires twice for each shot you take. On the third level, it is almost impossible for you to win, because the computer is firing three times for each of your shots. Your only chance is to get lucky and find all five of the enemy ships early in the game. The computer fires randomly, but it never hits the same spot twice.

After picking a skill level, you place your ships on the grid. The computer will ask you for a starting coordinate for the Carrier. You enter a coordinate in this format: a letter from A to J followed by a number from 0 to 9 (for example, D7 or J0). Next, you'll be asked to enter an H or a V to indicate if the ship is to be placed horizontally or vertically.

If you give an incorrect coordinate, or try to place two ships overlapping each other, or attempt to locate a ship in such a way that it would extend out of the grid, the program will say "Bad Coordinate" and start over again. The ship's coordinates will be drawn on the grid as they are entered.

After all five of your ships are placed, the computer will locate its ships. You can't see them, because they are drawn with programmable characters that look the same as those that form the grid.

Battle Is Joined

When the computer has located its ships, it will prompt you to give the coordinates of your first shot. Then the computer shoots. The hits and misses are displayed on the grid. If all your ships are sunk first, the computer will say "I win!" and show you where the rest of its ships are placed. When you score a hit on one of the computer's

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Address author correspondence to David V. Gardner, 2342 Barnes Road, Walworth, NY 14568.

Lines	
10–40	Display title page
50	Lower top of memory and randomize
60–80	Establish programmable characters
90	Set colors: tell computer to look in RAM for character information
100–120	Set skill level
130	Initialize variables
140–200	Draw screen display
210–360	Place friendly ships
370–440	Place enemy ships
450–580	Player fires at computer's ships
590–670	Computer fires back
680–700	Display hit and sank messages
710–750	End of game routine
760	Clear upper half of screen
770	Bad coordinate message
780	Time message display and then clear
790	Sound routine for shots
800	Clear enemy grid
810–820	Sound routine for hits
830	Flash hits
840	Ship names and hits required for sinking

Table 1. A general outline of the program listing for Sea Battle.

ships, it will tell you which ship it is, and when you sink a ship, the computer will also tell you that.

One feature of this game you may find interesting is the way the computer keeps track of the placement of the ships. The screen memory is used to store the information. The program allows the computer to Peek only at the locations where shots have landed. Consequently, it can't cheat by sneaking a look at the screen.

Because the ships have different screen codes, the computer can tell if a hit has been made and on which ship. This shows that the screen memory truly is in RAM and can be used for storing information as well as for displaying characters.

5K Is Enough

I wrote this program on a challenge from a friend. He had purchased a non-Commodore computer for which he was writing a version of this game. He ran into a minor programming problem, and I told him that he wouldn't have had that problem if he had bought a VIC-20.

He felt that the VIC's 5K of RAM wouldn't be enough memory for this game. I considered this a good chance to see just what would fit into the 3583 bytes that are available on the VIC. I think this game shows that a lot can be done within the VIC's limitations. Even though I now have a 16K memory expansion, I still do at least 90 percent of my work within the original 5K.

As a service to anyone who doesn't want to type in this program, I'll make it available if you'll send me a blank tape, a self-addressed stamped mailer and $3. R

Listing 1. Sea Battle program for the VIC-20.

```
10 PRINTCHR$(147):FORI=1TO9:PRINT:NEXT
20 PRINTTAB(5)CHR$(18)"-SEA BATTLE-":FORT=1TO1500:NEXT
30 FORI=1TO6:PRINT:NEXT:PRINTTAB(7)"BY DAVE GARDNER"
40 PRINT:PRINT" SETTING UP..."
50 POKE52,28:POKE56,28:CLR:POKE143,VAL(MID$(TI$,5,2))
60 FORI=7176TO7679:POKEI,PEEK(I+25600):NEXT
70 FORI=7168TO7174:POKEI,1:NEXT:POKE7175,255
80 FORI=7632TO7664STEP8:FORJ=0TO7:POKEI+J,PEEK(7168+J):
   NEXT:NEXT
90 PRINTCHR$(147)CHR$(5):POKE36879,110:POKE36869,255
100 PRINT:PRINT"CHOOSE SKILL LEVEL"
```

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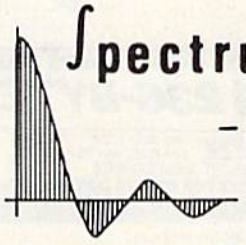

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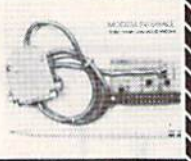

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Listing 1 continued.

```
110 PRINT:PRINT" EASY (1-3) HARD":INPUTU
120 IFU<1ORU>3THEN90
130 W=30720:S1=36876:S2=36877:V=36878:P=1
140 PRINTCHR$(147):FORI=1TO8:PRINT:NEXT
150 PRINT" 0123456789 0123456789";
160 FORI=7900TO8119:POKEI,0:NEXT
170 FORI=7900TO8098STEP22:POKEI,P:POKEI+11,P:P=P+1:NEXT

180 FORI=1TO10:PRINT:NEXT
190 PRINTCHR$(158)"--FRIENDLY----ENEMY--"
200 PRINT"---SHIPS------SHIPS--"
210 FC=7901:FORR=1TO5:READS$(R),SR(R)
220 PRINTCHR$(19)" ENTER "S$(R)
230 PRINT" COORDINATES":INPUTC$
240 PRINT" H FOR HORIZONTAL":PRINT" V FOR VERTICAL":INP
    UTD$
250 IFD$="H"THEND=1:GOTO280
260 IFD$<>"V"THENGOSUB760:GOTO770
270 D=22
280 GOSUB760
290 X=VAL(RIGHT$(C$,1)):V$=RIGHT$(C$,1)
300 IFASC(V$)<48ORASC(V$)>57THEN770
310 Y=ASC(C$)-65:IFY>9THEN770
320 IFLEN(C$)>2THEN770
330 FS=FC+((Y*22)+X):FORSC=1TOSR(R)
340 IFPEEK(FS)<>0THEN770
350 POKEFS+W,7:POKEFS,35
360 FS=FS+D:NEXTSC:NEXTR
370 PRINTCHR$(19):PRINT:PRINT"I'M PLACING MY SHIPS."
380 POKEV,15:EC=7912:MS=58:FORR=1TO5
390 CS=INT(RND(1)*20)+230:POKES1,CS
400 X=INT(RND(1)*10)+0:Y=INT(RND(1)*10)+0:D=INT(RND(1)*
    2)+1
410 IFD=2THEND=22
420 ES=EC+((Y*22)+X):FORSC=1TOSR(R)
430 IFPEEK(ES)<>0THEN800
440 POKEES,MS:ES=ES+D:NEXTSC:MS=MS+1:NEXTR:POKES1,0
450 GOSUB760:PRINTCHR$(19):PRINT"ENTER COORDINATES AND
    HIT RETURN TO FIRE"
460 FF=7912:INPUTF$:X=VAL(RIGHT$(F$,1)):V$=RIGHT$(F$,1)

470 IFASC(V$)<48ORASC(V$)>57THEN450
480 Y=ASC(F$)-65:IFY>9THEN450
490 IFLEN(F$)<>2THEN450
500 GOSUB760:GOSUB790:EF=FF+((Y*22)+X):PE=PEEK(EF):Q=0
510 IFPE=0ORPE=42THENGOSUB830:POKEEF,42:GOTO580
520 IFPE=58THENCA=CA+1:Q=1:HI=5:HS=CA
530 IFPE=59THENBA=BA+1:Q=2:HI=4:HS=BA
540 IFPE=60THENCR=CR+1:Q=3:HI=3:HS=CR
550 IFPE=61THENSU=SU+1:Q=4:HI=3:HS=SU
560 IFPE=62THENDE=DE+1:Q=5:HI=2:HS=DE
570 GOSUB680:IFEH=17THEN710
580 FORZ=1TOU:FORT=1TO500:NEXT
590 FF=7901:Y=INT(RND(1)*10)+0:X=INT(RND(1)*10)+0
600 FX=FF+((Y*22)+X):IFPEEK(FX)=42THEN590
830 FORJ=1TO10:POKEEF,42:FORT=1TO20:NEXT:POKEEF,0:FORT=
    1TO20:NEXT:NEXT:RETURN
840 DATACARRIER,5,BATTLESHIP,4,CRUISER,3,SUBMARINE,3,DE
    STROYER,2
```

Listing 2. Sea Battle program for the C-64.

```
10 PRINTCHR$(147):FORI=1TO9:PRINT:NEXT
20 PRINTTAB(14)CHR$(18)"-SEA BATTLE-":FORT=1TO1500
25 NEXT
30 FORI=1TO6:PRINT:NEXT:PRINTTAB(16)"BY DAVE GARDNER"
40 PRINT:PRINT" SETTING UP..."
50 POKE52,48:POKE56,48:CLR:POKE143,VAL(MID$(TI$,5,2))
56 POKE56334,PEEK(56334)AND254
58 POKE1,PEEK(1)AND251
```

More

Listing 2 continued.

```
60 FORI=0TO511:POKEI+12288,PEEK(I+53248):NEXT
62 POKE1,PEEK(1)OR4
64 POKE56334,PEEK(56334)OR1
70 FORI=12288TO12294:POKEI,1:NEXT:POKE12295,255
80 FORI=12752TO12784STEP8:FORJ=0TO7:POKEI+J,PEEK(12288+
   J):NEXT:NEXT
90 PRINTCHR$(147)CHR$(5):POKE53280,12:POKE53281,12
92 POKE53272,(PEEK(53272)AND240)+12
100 PRINT:PRINT"CHOOSE SKILL LEVEL"
110 PRINT:PRINT" EASY (1-3) HARD":INPUTU
120 IFU<1ORU>3THEN90
130 W=54272:P=1:WF=W+4:V=W+24:AT=W+5:SE=W+6:HF=W+1:LF=W
   :POKEV,15
140 PRINTCHR$(147):FORI=1TO8:PRINT:NEXT
150 PRINTTAB(10)"0123456789 0123456789"
160 FORI=1433TO1793STEP40:FORJ=0TO21:POKEI+J,0:POKEI+W+
   J,1:NEXT:NEXT
170 FORI=1433TO1793STEP40:POKEI,P:POKEI+11,P:P=P+1
175 NEXT
180 FORI=1TO10:PRINT:NEXT
190 PRINTCHR$(5)TAB(10)"--FRIENDLY----ENEMY--"
200 PRINTTAB(10)"---SHIPS------SHIPS--"
210 FC=1434:FORR=1TO5:READS$(R),SR(R)
220 PRINTCHR$(19)" ENTER "S$(R)
230 PRINT" COORDINATES":INPUTC$
240 PRINT" H FOR HORIZONTAL":PRINT" V FOR VERTICAL":INP
   UTD$
250 IFD$="H"THEND=1:GOTO280
260 IFD$<>"V"THENGOSUB760:GOTO770
270 D=40
280 GOSUB760
290 X=VAL(RIGHT$(C$,1)):V$=RIGHT$(C$,1)
300 IFASC(V$)<48ORASC(V$)>57THEN770
```

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Listing 2 continued.

```
310 Y=ASC(C$)-65:IFY>9THEN770
320 IFLEN(C$)>2THEN770
330 FS=FC+((Y*40)+X):FORSC=1TOSR(R)
340 IFPEEK(FS)<>0THEN770
350 POKEFS+W,7:POKEFS,35
360 FS=FS+D:NEXTSC:NEXTR
370 PRINTCHR$(19):PRINT:PRINT"I'M PLACING MY SHIPS."
380 EC=1445:MS=58:FORR=1TO5
390 GOSUB850
400 X=INT(RND(1)*10)+0:Y=INT(RND(1)*10)+0:D=INT(RND(1)*
    2)+1
410 IFD=2THEND=40
420 ES=EC+((Y*40)+X):FORSC=1TOSR(R)
430 IFPEEK(ES)<>0THEN800
440 POKEES,MS:ES=ES+D:NEXTSC:MS=MS+1:NEXTR
450 GOSUB760:PRINTCHR$(19):PRINT"ENTER COORDINATES AND
    HIT RETURN TO FIRE"
460 FF=1445:INPUTF$:X=VAL(RIGHT$(F$,1))
465 V$=RIGHT$(F$,1)
470 IFASC(V$)<48ORASC(V$)>57THEN450
480 Y=ASC(F$)-65:IFY>9THEN450
490 IFLEN(F$)<>2THEN450
500 GOSUB760:GOSUB790:EF=FF+((Y*40)+X):PE=PEEK(EF):Q=0
510 IFPE=00RPE=42THENGOSUB830:POKEEF,42:GOTO580
520 IFPE=58THENCA=CA+1:Q=1:HI=5:HS=CA
530 IFPE=59THENBA=BA+1:Q=2:HI=4:HS=BA
540 IFPE=60THENCR=CR+1:Q=3:HI=3:HS=CR
550 IFPE=61THENSU=SU+1:Q=4:HI=3:HS=SU
560 IFPE=62THENDE=DE+1:Q=5:HI=2:HS=DE
570 GOSUB680:IFEH=17THEN710
580 FORZ=1TOU:FORT=1TO500:NEXT
590 FF=1434:Y=INT(RND(1)*10)+0:X=INT(RND(1)*10)+0
600 FX=FF+((Y*40)+X):IFPEEK(FX)=42THEN590
610 GOSUB790:IFPEEK(FX)=0THENEF=FX:GOSUB830:GOTO670
620 IFPEEK(FX)=35THENPOKEFX+W,2:EF=FX:GOSUB830:POKEFX,4
    2:FH=FH+1
630 IFFH<>17THEN660
640 PRINT" I WIN!!"
642 FORI=1445TO1823:IFPEEK(I)>57ANDPEEK(I)<63THENPOKEI+
    W,3:POKEI,35
650 NEXT:FORT=1TO5000:NEXT:GOTO720
660 NEXTZ:GOTO450
670 POKEFX,42:NEXTZ:GOTO450
680 POKEEF+W,2:GOSUB830:POKEEF,42:PRINT"HIT "S$(Q):EH=E
    H+1:SS=2
685 GOSUB810:GOSUB780
690 IFHI=HSTHENPRINT"SANK "S$(Q):SS=4:GOSUB810:GOSUB780

700 RETURN
710 PRINT"YOU WIN!!":SS=8:GOSUB810
720 FORT=1TO2000:NEXT:PRINTCHR$(147):PRINT" PLAY AGAIN?
    (Y/N)"
730 GETPA$:IFPA$=""THEN730
740 IFPA$="Y"THENCLR:GOTO90
750 END
760 FORI=1024TO1265:POKEI,32:NEXT:RETURN
770 PRINT"BAD COORDINATE. START OVER.":FORT=1TO2500:NEX
    T:CLR:GOTO90
780 FORT=1TO1500:NEXT:GOSUB760:RETURN
790 POKEAT,9:POKESE,0:POKEHF,3:POKELF,244:POKEWF,129:FO
    RT=1TO600:NEXT
792 POKEWF,128:GOSUB860:RETURN
800 FORG=1TO10:FORH=1TO10:POKEEC+EB,0:EB=EB+1:NEXT:EC=E
    C+40:EB=0:NEXT:GOTO380
810 FORI=1TOSS:POKEAT,9:POKESE,0:POKEHF,71:POKELF,12:PO
    KEWF,17:FORT=1TO100
820 NEXT:POKEWF,16:NEXT:GOSUB860:RETURN
830 FORJ=1TO10:POKEEF,42:FORT=1TO20:NEXT:POKEEF,0:FORT=
    1TO20:NEXT:NEXT:RETURN
840 DATACARRIER,5,BATTLESHIP,4,CRUISER,3,SUBMARINE,3,DE
    STROYER,2
850 CS=INT(RND(1)*40)+210:POKEAT,9:POKESE,0:POKEHF,CS-1
    00:POKELF,CS:POKEWF,17
852 FORT=1TO50:NEXT:POKEWF,16
```

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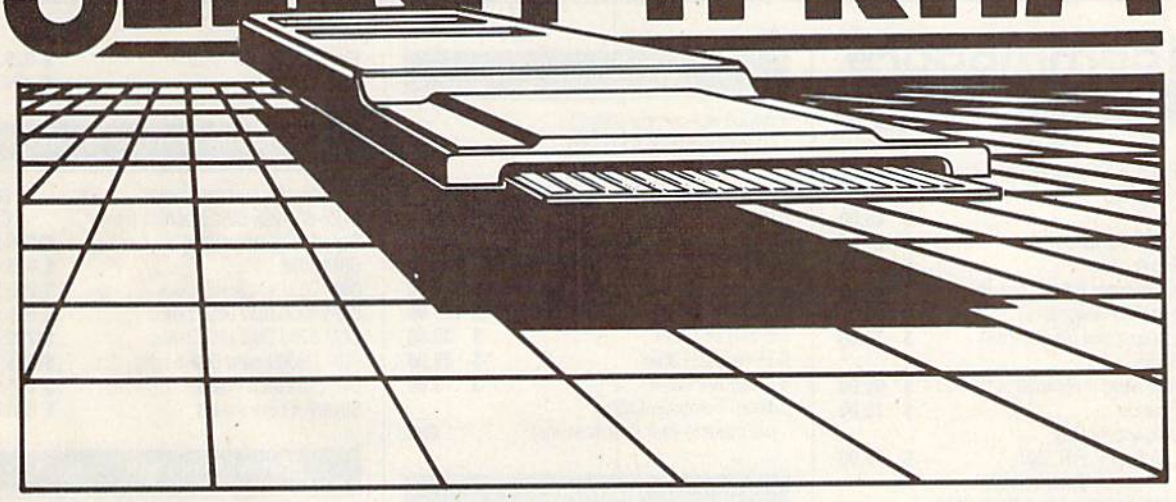

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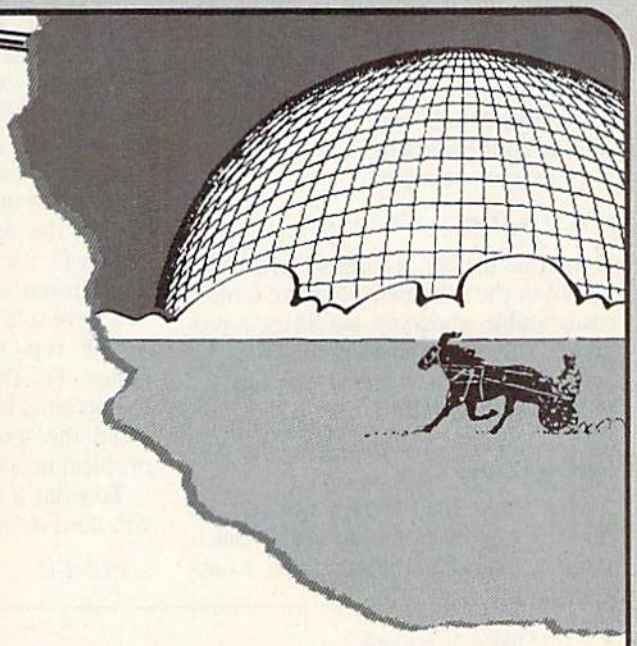
A Basic Excursion
Beyond the Manual

By Jeffrey Mills



Here's a lifesaver for the eager new owner of a Commodore 64. This is the first of a series of articles that will guide you carefully through the rapids and eddies of programming in Basic.

So you've read your manual. You've typed in the examples in the manual, too. But how do you fit all of that information together? Let's take a look at some of the things that you and your Commodore 64 can do.

The first step in using the computer effectively is to learn to program it to your needs. And what is a program? A simplified definition might be: A program is a set of detailed, step-by-step instructions that will direct a computer to perform a series of tasks, in a logical order, to accomplish a goal.

"But how do I even begin?" you are probably saying. Well, first let's discuss some basic housekeeping rules and then we'll start to develop a program.

Housekeeping Commands

1) *New*—The New command is a powerful one, which you must use with care. When you want to start a new program, New cleans out an old program already in memory. It will also clear out any variable storage that may be there from a previous program. We'll take a look at variables a little later.

But beware. Once you enter New, there's no way of recovering the old program, so remember to save it before using this command if you don't want it lost. To refresh your memory about New, see page 115 in your *Commodore 64 User's Guide.*

2) *CLR*—This command "clears" the computer's memory without changing or erasing any program that may be in memory. All the variables are reset to zero, and the pointers are returned to their beginning states. (Pointers are the addresses of various important items that the computer must keep track of when a program is running.) CLR is covered on page 117 of the User's Guide.

Address author correspondence to Jeffrey A. Mills, PO Box 06021, Columbus, OH 43206.

3) *List*—This command let's you see a listing of the program you're working on. To stop a List, use the run/stop key.

You can set List so that only certain parts of your program appear. This is done by specifying the line numbers you want to see. For example:

- **LIST 100-200** (lists all lines from 100 through 200), or
- **LIST -999** (lists all lines up to and including 999), or
- **LIST 345** (lists just line 345).

The command List, given without any line numbers, will list the entire program. List is defined, with examples, on page 115 in your User's Guide.

4) *Line Numbering*—When you write a program, the computer needs to know the order in which to perform the various tasks. This is done with line numbers, which may range from 0 to 65535.

When numbering your program, it's best to count by tens (10, 20, 30, 40...). This allows you to go back later and insert a line you may have forgotten. For example, you may need to put something in between the first line (10) and the second (20). You may simply number the new line 15. If the lines were numbered 1, 2, 3, 4..., we couldn't have entered a line between 1 and 2.

5) *REM*—This command, which introduces

an explanatory remark, does not affect the operation of the program in any way, but simply makes clear what you intend the program to do at that point. This documentation is quite important, since you can easily forget what you were doing after some time has passed.

REM is the first statement you will be shown how to use in an actual program. (The commands already explained are ordinarily entered directly from the keyboard.) REM statements also provide the programmer's most useful tool in discovering why a program doesn't work properly. So use them liberally in writing your programs.

Here is an example:

```
10 REM *** THIS IS A REMARK ***
```

Note the use of asterisks, which are placed in the statement to make it more easily visible when you are listing a program. Although not necessary, they are helpful. REM is explained on page 124 of the User's Guide.

Getting Started

The first thing you must do in developing a program is to decide exactly what you want the computer to accomplish. The example I'm going to lead you through will allow the Commodore 64 to keep a listing of all of your programs, with the numbers of the tapes they're saved on.

Let's start with a remark to identify the program and its author. Type in

```
10 REM *** PROGRAM/TAPE CATALOG ***
20 REM *** WRITTEN BY: your name **
```

The next step will be to clean up the screen, where you'll be displaying your catalog of programs. You can accomplish this from within the program by using an "embedded command" in a Print statement.

The Print statement tells your computer to put something directly onto the screen, starting on the next available line. If the screen is full, the Commodore will "scroll" the text upward to make room at the bottom for the line you have told it to Print.

The top line then disappears, of course. For this reason, you should, for the present, limit your list to 15 lines to avoid the scrolling. I'll deal with that problem in a later article.

To print a number on the screen, all you need do is use a line like:

```
30 PRINT 12
```

When it reaches line 30, the computer will print the number 12 on the screen.

To print a word, you must enclose it inside quotation marks. For example:

```
30 PRINT "TWELVE"
```

The computer will duly print the word TWELVE on the screen when line 30 is reached.

Just as you can print a word, you can print any of the command keys from the keyboard. These are called embedded command characters. When printed, they will perform their assigned tasks, such as moving the cursor (indicating the location where the next item will print) or clearing the screen.

If you want to clear the screen, you type:

```
30 PRINT "[Shift-CLR/HOME]"
```

Typing that key inside quotes does not immediately clear the screen. What appears is a reversed "heart" graphics character. Its presence will clear the screen at the intended moment when the program is run. (When you embed a command, it is always displayed as a reversed character, different, of course, for each key.)

There is no place in the manual where

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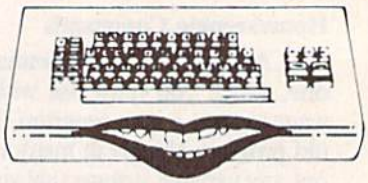

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embedded keyboard commands are specifically covered. It will take you awhile to learn which reversed character represents each command key. However, those in frequent use will soon become second nature to you.

It may be helpful to know that when you type in a program (or a direct statement), you may use a question mark to represent the word PRINT. When you list the program, the word PRINT will appear. (There are a number of other abbreviated words listed in a table on pages 130–131.)

The PRINT statement is covered in the manual on pages 22–29 and pages 123–124.

Heading and Spacing

Now that you've told the computer to clear the screen, you can print a heading.

There are several ways you can center the heading. For now, just include spaces in the print statement. Type:

```
40 PRINT "                    TAPE CATALOG"
```

There are 14 spaces in the print statement.

Why 14? The heading itself takes up 12 spaces and there are 40 spaces to a line on the screen. That leaves 28 spaces to be divided evenly on both sides.

To provide for a blank line after the heading, before you start the catalog list, just print a line with nothing on it; like this:

```
50 PRINT
```

Before proceeding with the listing, you need to know some of the simpler methods of making the screen output orderly.

There are two simple ways to space screen output: the comma and the semi-colon. If you use the semi-colon, your output will not have any spaces from one field to the next. (Field is the term for a group of characters that form a part of a complete record. For example, the tape number in your current program will be one field; the name of the program will be another. Both fields combined form the complete record.)

If you print your output with commas, it will be spaced on the screen into what are called print zones. The 64's print zones are ten spaces long. Each field will begin at the next available print zone. Here are a couple of examples.

Assume that you have two programs you want to list in the catalog listing. Call them Game 1 and Game 2, and assume they are saved on tape 101. Now output the two programs in the catalog with print statements. Type:

```
60 PRINT "101";"GAME 1"
70 PRINT "101","GAME 2"
```

Notice that line 60 is printed with a semi-colon, but line 70 with a comma.

Run the program and note the difference in the two lines. The first line has no spaces between the fields, while the second is printed in individual zones.

If the "number" entry in line 70 had contained more than ten characters, the program name would have been printed at the start of the next available print zone (in this case, column 20 instead of column 10).

Now change line 60 to match line 70. Type:

```
60 PRINT "101","GAME 1"
```

Both lines will now be spaced evenly when you run the program.

You now know how to type a program line with a separate Print statement for each of your catalog entries, so go ahead and complete your list.

Next month I'll discuss a couple of alternative ways your Commodore 64 can simplify the task begun in this issue. R

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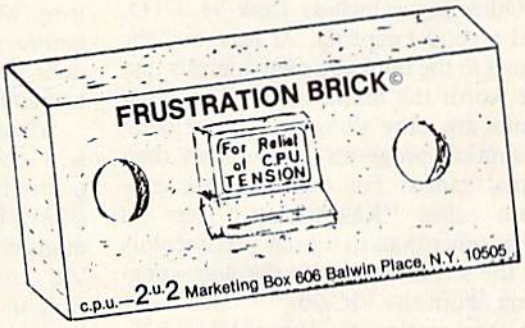

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VIC Games

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Most early computer game books had extremely simple games to match the capabilities of the computers they were written for. This book, however, is worthy of the impressive graphics, sound and games-playing capabilities of the VIC-20. There are few "throw-aways" here, and most are genuinely entertaining, playable offerings.

Though Basic is the primary tool, Hampshire demonstrates what the VIC-20 can do using clever programming techniques. An amusing version of Breakout is included, along with a joystick-controlled Space War that features ships fighting each other and the sun's gravity. The obligatory Hangman and Mastermind are present—each has an original Hampshire touch.

Other games include Tank Vs. UFO, and a good Leapfrog. At least half the games in the book are solid contests that are worth the asking price. The other games are more along the lines of demonstration programs and utilities than actual games. For example, one program called "Kaleidoscope" has no point other than to dipslay pretty colors on the screen and teach the user something about the VIC-20.

Other programs demonstrate high resolution, enable the player to draw on the screen, experiment with sound effects, or load programs from tape more quickly. Not exactly games, but, considering their educational value and fun, not a waste either.

One minor complaint: the program listings can be hard to read. Specifically, the VIC-20 special characters are not always reproduced very clearly. A dot-matrix printer was used with the actual characters shown, rather than the word conventions used by *RUN* magazine, and some other publications. Still, you can usually decipher the meaning.

David Busch
Kent, OH

Stimulating Simulations For the VIC

C.W. Engel
Hayden Book Co., Inc.
50 Essex St.
Rochelle Park, NJ 07662
Softcover, 91 pp., $7.50

Computer models have always been popular games. Hammurabi-like clones flourished a few years ago, and even Star Trek games and their spin-offs are basically nothing more than models of imaginary situations for games players. The object is to take the resources at hand and use them to solve some problems, whether it be destroying Klingons before running out of Photon torpedoes or surviving 20 years of poor harvests.

Stimulating Simulations for the VIC is a collection of 12 simulation programs for the VIC-20. Scenarios vary from a fishing trip to an encounter with monsters. Other simulations model a trip through space, an art auction and a stint in the hectic world of business. Whether or not these games truly reflect the subjects on which they were modeled (they don't) is immaterial. More important, they have educational value, and they're fun.

Flowcharts accompanying the games enhance their learning value. Also, Engel shows how different variables were used in the programs and offers hints on how to change the variables to affect play. While this technique can be used to make the games more fun, it also serves to teach you something about how the program works.

The program listings, which were printed on a daisywheel printer, are very easy to type in and read. Special VIC-20 control characters are neglected to the point where they are not even used to clear the screen. It appears as if these games were written for some other computer system and adapted for the VIC-20, since they use a plain vanilla Basic that ignores the VIC-20's capabilities.

On the one hand, that makes the simulations easy to understand and to transfer to another computer. On the other hand, all have to be classified as "word" or "text" games with no graphics to speak of.

David Busch
Kent, OH

Machine Language For Beginners

Richard Mansfield
Compute! Books
PO Box 5406
Greensboro, NC 27403
Softcover, 350 pp., $12.95

The majority of books on machine language programming for personal computers assume you are familiar with both the details of microprocessor chips and with programming techniques. This new offering assumes only a working knowledge of Basic. It was designed for the amateur programmer—the part-time computerist. It should help you make the transition from Basic to machine language with relative ease.

This book was not written for one specific system, but it does limit itself to the 6500 series microprocessors. You'll find specific comments regarding the Commodore, Atari and Apple systems with hints as to applicable differences

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The Commodore 64™ Picture Book
The VIC™ Picture Book

(Nadler) Here's the best way for first-time VIC and Commodore 64 owners to get started—simple pictorial guides that explain all operating and programming functions, from opening the box to setting up hardware to programming. Everything is explained and demonstrated in sequential photos. You follow along visually. No confusing instructions. No "computerese". Even programming exercises are illustrated. You check your results against photos of what should appear on the screen. A quick way to advance to more sophisticated techniques and routines.

Commodore 64™ version, #6453, $10.95
VIC™ version, #6303, $10.95

Commodore 64™ Programs for the Home

(Sternberg) A collection of 39 programs for every member of the household. Includes home budget programs, educational games, and programs for managing finances, arranging schedules, and more. Each program is documented with a description of its function, a listing in Commodore 64 BASIC, a symbol table, sample data, and a sample run. **#5176, $13.95**

VIC™ Games

(Hampshire) Contains 36 exciting game programs. Arcade-style and strategy games provide challenges, test nerve and patience. Drive the Grand Prix, battle space pirates, solve the Rubik's Cube. Educational games also provide hours of fun while improving vocabulary and spelling skills.

#1060, $12.95

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(Engel) Unique game programs that require no programming expertise. Includes: **Devil's Dungeon:** Unheard of wealth in the dark, deep caves. Watch out for the volcanic tremors, bottomless pits...and the monsters. **Lost Treasure:** It's buried somewhere on the island. Stick to the map route. The woods are uncharted and the waters shark infested. **Jewel Thief:** The museum, the priceless jewel, the five suspects—who done it?

And nine other fascinating games that have you battle a forest fire, manage a corporation, pilot a space ship, and more.

Commodore 64™ version, #5201, $7.50
VIC™ version, #5173, $7.50

VIC and Commodore 64 are trademarks of Commodore Business Machines, Inc., which is not affiliated with Hayden Book Company, Inc.

Basic Commodore 64™ BASIC

(Coan) The key to using and enjoying the Commodore 64—a fast reading guide to operating and programming. The approach is simple and direct. Start with short computer programs. Add a new capability. Watch as the desired effect on the program is created and illustrated. Based on Hayden's best-selling *Basic Apple BASIC*. **#6456, $14.95**

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VIC™ Graphics

(Hampshire) Produce dazzling graphics with programs that include color plotting, drawing maps, rainbows, geometric figures, pie charts and line graphs, character and shape design, moving figures on the screen, and more. Programs develop, revealing techniques for three-dimensional drawing, and for adding perspective.

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when trying to attempt certain tasks. All programs presented in the book have separate versions for each of the systems mentioned.

The introductory sections explain what machine language is and why programmers use it, giving comparisons between Basic and machine language. Chapter 1 explains how to use the book before presenting the material to be covered. The remaining chapters walk you through the material in a very logical and easy-to-follow format.

You start with fundamentals, covering numbering systems, loaders, monitors and other programming tools that make learning easier as you go on. Then the different 6502 addressing modes are explained with plenty of examples and illustrations. Later, you learn about doing arithmetic and comparisons using machine language, which is not always as easy as you might think.

Finally, you work your way through the 6502 instruction set, broken down into six easy-to-manage groups: transporters, arithmetic, decision-makers, loops, subroutines and jumps and finally, debuggers.

Each of the instructions is compared to similar Basic commands or functions to make learning easier. There's even an entire chapter devoted to machine language equivalents of various Basic commands. You get to see things from both sides of the fence.

The entire book is about 350 pages and spiral bound. The actual text is only about 150 pages, while the remaining pages contain very handy appendices. They include detailed instruction descriptions for the 6502 along with memory maps for the PET, CBM, VIC, C-64 and Atari. You'll also find notes on assembling, along with a simple assembler program written in Basic.

For Commodore owners, there's complete information and hex dumps for Micromon and Supermon, along with a discussion of Wedge-type programs. There is even a number conversion table and lists of further references.

I think this is an excellent book for anyone considering learning machine language programming. It is well written and easy to follow, and everything is presented in a logical and orderly fashion. It definitely accomplishes the goals it was designed to achieve, addressing the novice programmer with a working knowledge of Basic. Based on the number of copies being sold by various dealers, I guess I'm not the only one who feels this way!

Robert Baker
Atco, NJ

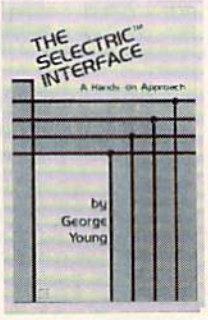
VIC Revealed

Nick Hampshire
Hayden Book Co., Inc.
50 Essex St.
Rochelle Park, NJ 07662
Softcover, 267 pp., $12.95

Here is a book for all serious VIC-20 programmers. It contains a wealth of information on the VIC-20.

Chapter one lets the reader know right where he is heading—into the deepest levels of his machine. Topics discussed are 6502 architecture, address modes, instruction set and initialization.

BOOKS Wayne Green Books BOOKS



Nanos System Reference Cards for the VIC-20, C-64, and 6502

No more flipping through the Commodore manuals to find information you need. Nanos System Reference cards are pocket-sized summaries for your quick, easy reference. Find BASIC commands and instructions, ROM routines, reserved words, I/O instructions, hex conversions, screen line layout, and more.

VIC-20	FC1015	$5.95
6502	FC1016	$4.95
C-64	FC1017	$5.95

Inside Your Computer

Find out what goes on inside your VIC-20 or C-64. Inside Your Computer *explains microcomputer circuits and how they work. Topics include chips, interpreters, circuits, machine language, binary numbers, algorithms, ASCII code, software, and what they all mean to the computer. Includes many photographs and schematics.*
$12.97 BK7390 108 pp.

Rainbow Quest for the Commodore 64

A computer fantasy for young C-64 users. Rainbow Quest *is an adventure that combines fiction and programs. Readers must cross the planet Rainbow and master a series of challenges to succeed on the Quest. Each challenge is a program on cassette. Included are arcade games, puzzles, and mazes. Book and cassette sold together.*
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The Selectric™ Interface

You can turn an IBM Selectric I/O writer into a letter-quality printer for your VIC-20. The Selectric Interface *gives you the programs and step-by-step instructions you need for Selectric models 2740, 2980, and Dura 1041. With slight modification, the instructions will also work for the C-64.*
$12.97 BK7388 124 pp.

For credit card orders, call toll-free, 1-800-258-5473. *Or send your order on a separate piece of paper to:* **Wayne Green Books, Retail Sales, Peterborough, NH 03458** *Be sure to include the book title, order number, and price. Postage and handling is $1.50 for the first book, $1.00 for each additional book. Check, money order, or complete credit card information must also accompany your order. If you have questions about your order, write customer service at the above address.*

Methods of using machine language from Basic programs and as system wedges are discussed. Also introduced are a Basic hexadecimal loader program and a very brief "how-to" on machine language programming.

Chapter two was worth the cost of the book. It is a complete discussion of the VIC operating system, complete with memory maps, tables of system variables, important memory locations and tables of the Basic and kernal routine addresses. Covered in detail are the use of memory and storage formats performed by the operating system for program and data storage. Also presented are initialization as normally performed from a cartridge, and examples of system wedges.

The third chapter explains and illustrates the operations performed by the 6561 video interface chip. All registers are discussed thoroughly. Each explanation of a register is accompanied by a short Basic program that illustrates the ranges of control and functions of the register. Important information is provided on high-resolution graphics, the multicolor mode and sound. Listings of two high-resolution graphics programs (requiring a 3K memory expansion) are provided.

A brief review of the VIC input/output lines and operation of the 6522 VIA is provided in the fourth chapter.

Chapter five provides explanations and pertinent facts concerning: the cassette port and cassette signal format; the keyboard and scanning routines; the RS-232 port, joystick and paddle functions; and the serial IEEE-488 port and protocols. There is an inadequate description of the memory expansion port.

Three of the appendices are run-of-the-mill code conversion tables and instruction sets. Appendix two is a machine language wedge which adds commands to Basic, including some sound and graphics commands. Appendix five is a set of circuit schematics for the VIC-20, and Appendix six discusses the commands and functions available on the Commodore Machine Language Monitor cartridge.

This book is for the serious programmer and VIC-20 explorer.

The print quality of the book is fair. There are several typographical errors, and an errata sheet correcting these is provided.

Don't buy this book to learn machine language programming, or for technical discussions of the 6502, 6522 or 6561. There are better publications available for that. Do buy this book if you are serious about deeper programming and exploration of your VIC-20. Just the discussion of the operating system makes this book a good addition for your reference library. My copy resides just a short reach away from my VIC!

Thomas Franks
Wadsworth, OH

Circle 201 on Reader Service card.

MicroBase written by aliens

ARFON DENIES UFO INVOLVEMENT

Lafayette,LA--Officials at Arfon Microelectronics today denied connections between their program MicroBase and recently reported UFO landings in the surrounding Atchafalaya Basin. In a daring midnight raid, Lafayette police apprehended Patrick Doyle, vice-president of the company, and several co-workers, as they tried vainly to escape in their pirogue. The police report alleges that the suspects were seen accepting computer programs, thought to be MicroBase, from a reportedly alien vehicle. Doyle released the following statement on Monday morning:

"I would like to reply to the allegations that our program MicroBase was written by aliens. I will concede that MicroBase is out of this world, with its speed, simplicity, and versatility, but it most certainly is not the product of little green men.

"For the record, let me state that MicroBase was written by a human being like you or me, who was concerned about the lack of quality personal data bases for the VIC 20 and Commodore 64. So he came up with MicroBase, the first data base to run interchangeably on the VIC and 64. MicroBase has all the features of the bigger data bases: user-configurability, sort capability, and seven different search parameters. It allows up to 12 fields per record, up to 80 characters per field, and up to 196 characters per record. And it's memory-resident, so it's faster than disk or tape-resident data bases.

"We can only speculate that the UFO rumors were started because of MicroBase's unearthly price--only $29.95 for tape and $34.95 for disk."

When asked just what he and the Arfon staff were doing in the middle of a swamp at midnight with a Commodore 64 and an undisclosed number of MicroBase programs, Doyle replied, "Cataloging the alligators, of course."

For more information about MicroBase and other Arfon products, call (318) 988-2489 or write Arfon Micro, 111 Rena Drive, Lafayette, LA 70503. Dealer inquiries are welcome.

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DISK UTILITIES
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****DISK SUPPORT ($14.95 postage paid)****

This program, written for the VIC-20 and COMMODORE 64, provides a 1K machine language extension which adds twelve new commands to your computer's operating system. Not to be confused with the combersome "wedge", DISK SUPPORT offers 12 separate, easy to use, two-keystroke commands which WORK! You can SAVE with *automatic VERIFY*, SAVE-WITH-REPLACE (eliminating Commodore's DOS bug), LOAD, VERIFY, DELETE, and RENAME disk files with just two keystrokes. Also provided are commands which INITIALIZE, FORMAT and VALIDATE a diskette, EXECUTE any program on the diskette, print the ERROR message to the screen, and list the diskette's directory to the screen (formatted for your computer's display) without affecting the contents of the computer's memory; all with only two keystrokes. DISK SUPPORT is compatible with all memory expansion cartridges, the SUPER EXPANDER and PROGRAMMERS' AID cartridges, and Micro Systems Development's VIE-20 and CIE-64 IEEE interface cartridges. DISK SUPPORT is designed to work equally well with both single and dual disk drives and is a MUST for all disk drive users!

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DISK DUPLICATOR is a machine language program which provides you (the owner of a 1540, 1541 or 2031 single disk drive) a fast and convenient way to make back-up copies of your precious, irreplaceable diskettes. DISK DUPLICATOR is 100% MACHINE LANGUAGE, 100% FAST, and most importantly, 100% AFFORDABLE! Diskettes are copies verbatim with as few as 4 exchanges (using a COMMODORE 64). Don't let an accident or a mistake catch you without back-up copies of all your diskettes. ORDER "DISK DUPLICATOR" TODAY!

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GamesRUNdown

Compiled by Shawn Laflamme

The Hustler Returns

Pool-64 and Pool-20 bring the billiard parlor to your home without the necessity of sitting in a dark, smoke-filled back room. Written for the Commodore 64 and the VIC-20, both games use high-resolution graphics.

You can play either nine-ball or straight-pool. You control the speed and angle of the cue ball right from the keyboard. Take your shot, watch the balls roll and then listen to the clatter as they hit each other. If you make a bad shot, you can try again (no cheating allowed).

Pool-64 and Pool-20 are available on cassette for $14.95 and disk for $17.95 from Abacus Software, PO Box 7211, Grand Rapids, MI 49510.

Check Reader Service number 436.

Baldor's Castle

Arfon Micro (111 Rena Drive, Suite C, Lafayette, LA 70503) has released a new game for the VIC-20.

Baldor's Castle challenges you to fight off nine different types of monsters as you attempt to steal Baldor's gold. You can try to fight off the monsters with your bare hands (if you are able) or with bow and arrow, magic sword, potions and more. The castle contains more than 70 rooms on three levels.

It is available on cartridge and sells for $29.95.

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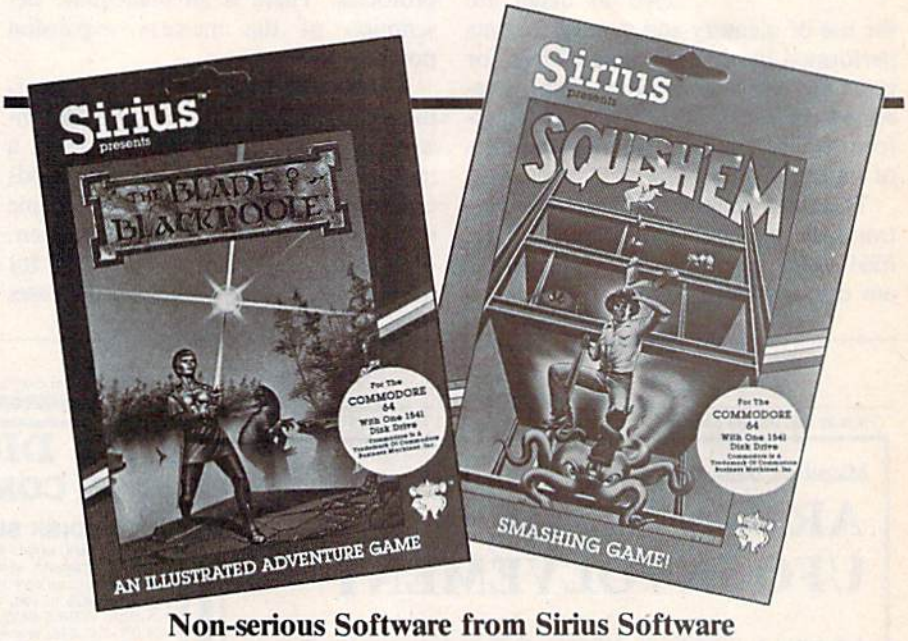

Non-serious Software from Sirius Software

Sirius Software, Inc. (10364 Rockingham Drive, Sacramento, CA 95827), has released three games for Commodore owners.

Squish 'Em is now available for the VIC-20. As you climb a 48-story building under construction, various objects fall toward you from above—everything from bricks to the kitchen sink—and menacing monsters try to knock you off. You can dodge the monsters as they chase you or jump over them if you like—or you can always "squish 'em."

Squish 'Em features 15 levels of play. It is available on cassette (8K memory required) for $19.95. It is also available on disk for the Commodore 64.

Blade of Blackpoole is an advanced, single-player adventure game with numerous puzzles to challenge you as you try to find the magical sword, Myraglym. You encounter objects that may or may not be useful in your quest and must continually make choices, meet challenges and solve problems in order to continue. The game has provisions for storing and returning up to ten stages of play. It allows you to string multiple actions into single commands, and it has a large word-recognition capacity.

Blade of Blackpoole is available on disk for the Commodore 64. It costs $39.95.

Gruds in Space is a single-player adventure game for the Commodore 64. It puts you in search of a stranded spaceship to which you must deliver rare fuel. Using such techniques as teleporting and warp drive, you visit 110 different locations, covering most of the planets in the solar system, on your quest. The game features colorful animation sequences. It costs $39.95.

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The Demonstration Package, which shows how each program runs, is available for $19.95. So, if you're serious about your 64, call or write for a complete brochure or **go right down to your nearest computer retailer for a demonstration.**

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and The Alien said..."Let Commodore Speak... and Sing!"

Yes, the VOICE BOX™ from The **Alien** Group, the world's ONLY *singing* speech synthesizer, now grants the power of speech to the VIC 20™ and the Commodore 64™. A commented, all-BASIC demo program gets the VOICE BOX talking right away, and, since it can be "taught" to say anything, the VOICE BOX has an unlimited vocabulary! The voice speaks with natural speech inflection controlled either from the program or from the precise, built-in Pitch control. *No other speech synthesizer has this feature!*

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The VOICE BOX plugs directly into the computers user port, comes with built-in speaker, Volume and Pitch controls and lots of instructions from The **Alien** Group, the people who got Atari® and Apple® to speak!

Available at leading computer stores everywhere, or order direct by sending $129. to: The **Alien** Group, 27 W. 23rd St., NY, NY 10010. Specify whether for VIC 20, Commodore 64 cassette or Commodore 64 disk. Programs for a high-res talking human face and a comprehensive music and singing system available on separate cassette for $25.00 (expanded RAM necessary when used on VIC 20). Extra main cassette for either computer available for $19.00.

Vic 20 and Commodore 64 are tradenarks of Commodore Electronics Ltd. VOICE BOX is a trademark of The **Alien** Group.

Two Sports Strategy Games

Parr Programming (2664 Tyler St., Gary, IN 46407) has introduced two sports strategy games on cassette for the VIC-20.

In Baseball Adversary, you make managerial decisions against your computer opponent. Additional players on the bench allow for pinch hitting and relief pitching. It requires no memory expansion and costs $10.95.

Football Adversary places you in the role of head coach opposing the computer. Features include a selection of 31 plays and a display of halftime/game statistics. It requires 8K memory expansion and costs $14.95.

Check Reader Service number 415.

Casino Roulette

Casino Roulette (Powerline Software, PO Box 635, New Hartford, NY 13413) is a casino style roulette game for the VIC-20 and the Commodore 64.

The game uses sound, color and graphics; it produces a roulette board display and places chips as bets are placed. Options selected when the game is started allow for European or American style play and for changing casino payoffs on winning bets.

Up to five people may play at once and the game keeps a running tally for all players and the casino. Each player may wager up to 60 different bets.

A cassette tape version is available for the VIC-20 with an extra 8K, and both cassette and disk versions are available for the Commodore 64. Each version costs $19.95.

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Lazer Maze D	29.95	20.70

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There are screen layouts of 18 different holes, with full screen enlargement of greens for putting. Hole distances, par, yards to green, strokes taken on hole, total strokes per round and player totals are displayed. It is available on disk for $29.95.

Canadian Micro Distributors, 500 Steeles Ave., Milton, Ontario, L9T 3P7.

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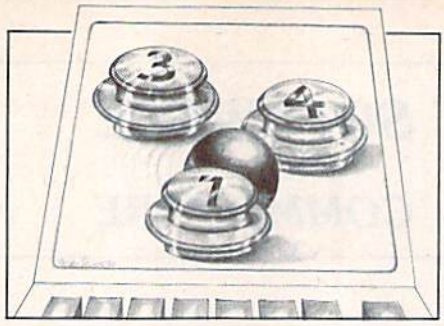

Midnight Magic

David's Midnight Magic is a pinball game now available for Commodore 64 users.

It simulates dual flipper controls, bumper action, rollovers, multiple ball play and the sounds and lights of a classic arcade pinball machine. You can jostle the machine, but if you overdo it, you'll ring up a tilt. The game also keeps a list of your all-time highest scores.

David's Midnight Magic is available on disk for $34.95 from Brøderbund Software, 1938 Fourth St., San Rafael, CA 94901.

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Dogfight Action

Eagles, a new strategy simulation game, is available for the Commodore 64.

Eagles takes you over France during World War I; the game gives you 14 historic planes, including the Fokker DR-1 Triplane (the Red Baron's favorite) and the legendary Sopwith Camel. Each plane is rated for speed, rate of climb and maneuverability. If you like, you can also fly planes of your own design.

You can fly against enemy planes flown by the computer, or against other players. Balloon-busting missions, duels between single aircraft and dogfights involving as many as 20 planes are all possible with Eagles. You can choose historic scenarios, or let the computer set up the battles.

Eagles is available on disk for $39.95 from Strategic Simulations, Inc., 883 Stierlin Road, Bldg. A-200, Mountain View, CA 94043.

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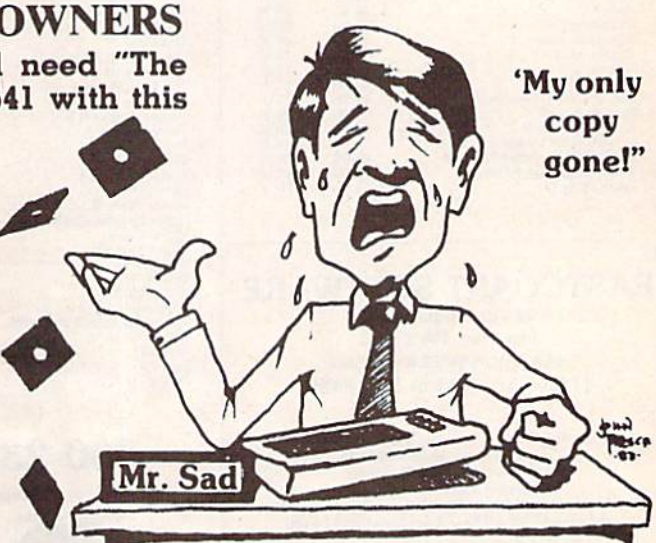

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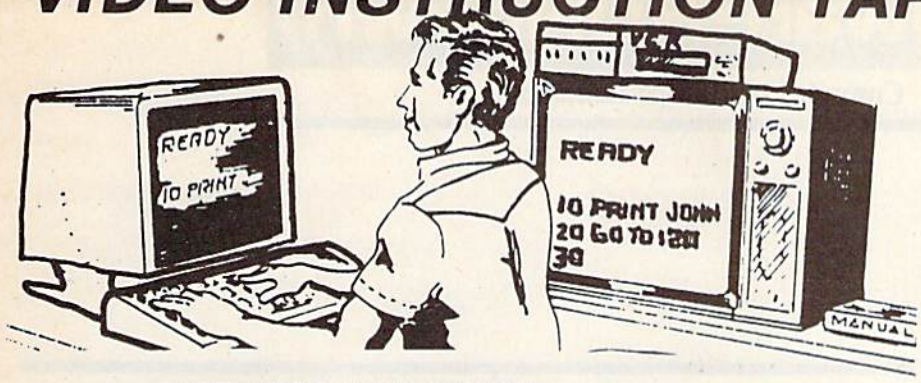

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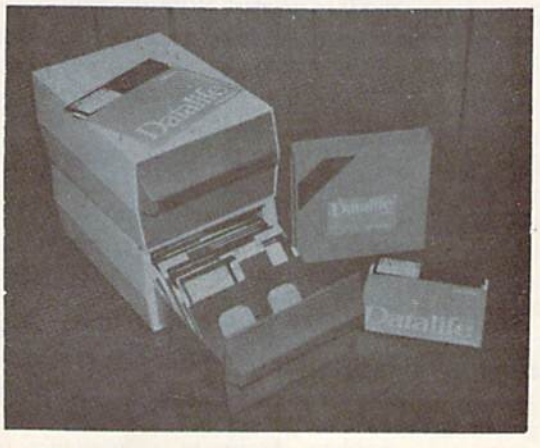

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Hardware RUNdown

Compiled by Shawn Laflamme

Predict the Weather

Vaisala, Inc. (2 Tower Office Park, Woburn, MA 01801), has released HAWS (Home Automatic Weather Station) for the Commodore 64 and the VIC-20. HAWS is a weather sensor with a software package that teaches, forecasts and graphically displays weather.

HAWS allows you to monitor weather conditions inside or outside your home and interact with the software program to help predict and cope with changing weather conditions. HAWS also allows you to rate your forecasting performance against your local weatherman's predictions.

HAWS can be used as an educational tool for teaching meteorology concepts and for learning about weather, either in the home or in the classroom. It can also be used to monitor and control indoor living space, greenhouses, office environments, etc.

The HAWS package is priced at $199.95 and includes sensor, choice of cassette tape or disk program, 15-foot cable with connector for the computer and a user's manual.

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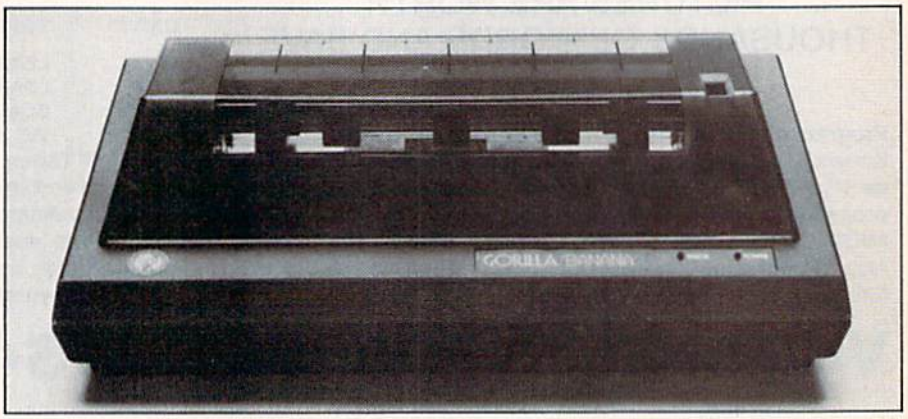

The Connection

The Connection is a printer interface for the VIC-20 and the C-64. It plugs into the serial port just like the Commodore printer. With the Connection, you can use any one of the many quality dot-matrix and daisy-wheel printers (Centronics parallel interface) with your Commodore.

The Connection operates with or without a disk drive and is totally transparent to the computer. (This means that it will operate with virtually any applications program without modification.)

The Connection has several modes of operation. The Emulation mode duplicates the features found on Commodore's 1525 printer. This includes the graphics characters, column/dot tabbing and graphics repeat functions. The Text mode replaces graphics symbols with equivalent text representations. The Transparent mode is used to access all of the special features of the specific printer being used.

The Connection also includes a 2K buffer, a printer self-test, LED status indicators and a printer reset switch. It costs $119 and is distributed by Micro-Ware Distributing, Inc., 1342 B Route 23, Butler, NJ 07405.

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Go Ape!

The Gorilla Banana, from Leading Edge Products, Inc. (225 Turnpike St., Canton, MA 02021), is an 80-column, tractor feed printer available for $249.95. It is capable of printing alphanumerics or graphics on fan-fold forms from 4½ to ten inches wide. Its print speed is 50 characters per second.

The Banana's print head is of unihammer design. Characters are printed in a 5×7 matrix similar to that used by many CRT terminals. Normal character spacing is the standard ten characters per inch, equivalent to pica typewriting, with a maximum 80-character typing line. Double-width characters (five per inch) can be substituted under software command.

The printer also features both a character and a dot-addressable graphics mode, with a density of 63×60 dots per inch. Line spacing in graphics mode is reduced to nine lines per inch, allowing graphics characters on adjacent lines to abut when desired.

A Centronics-type parallel interface allows direct hookup to the VIC-20 and the Commodore 64. The Banana is 16"×5"×8" and weighs 12 pounds.

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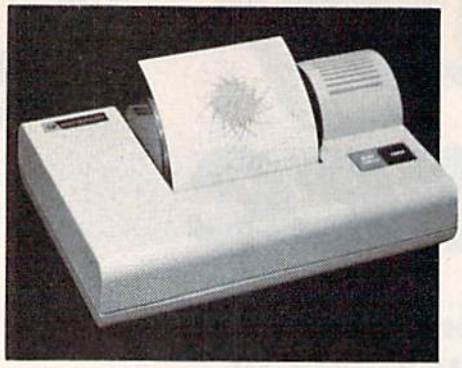


Two Alphacom Printers

Alphacom, Inc. (2323 South Bascom Ave., Campbell, CA 95008), has introduced two low-cost printers for the Commodore 64 and the VIC-20.

The Alphacom 42 is a 40-column printer with graphics capabilities for the C-64 and the VIC-20. It is priced at $179.95.

The Alphacom 42 can be linked to the VIC-20 or the C-64 by simply plugging the appropriate interface cable into the printer's cartridge-like slot. Prices of cables begin at $29.95.

The Alphacom 81 is an 80-column printer priced at $169.95. The printer's features include friction feed and the capability for bit-mapped graphics. Interface cables are available for the VIC-20 and the C-64 with prices starting at $44.95.

Both the Alphacom 42 and the Alphacom 81 feature upper/lowercase letters and wraparound facility. They also recognize standard ASCII control or "action" codes for changing the printing mode. Codes include carriage return, line and multi-line feed, right justification, form feed and graphics control.

The Commodore cable will plug directly into the serial bus connector and provide for the full Commodore character set, including continuous graphics and bit-mapped graphics using Basic software.

Check Reader Service number 432.

Supercord

Supercord, from Cord Ltd. (1548 Brookhollow Drive, Santa Ana, CA 92705), is a computer-typewriter interface that is capable of linking nine different brands of electronic typewriters with the VIC-20 and the Commodore 64. Supercord allows you to combine the advantages of a personal computer with those of an electronic typewriter.

The list of electronic typewriters able to use the Supercord includes Adler, Brother, Royal, Smith-Corona, Silver-Reed and others.

Supercord is offered in a variety of combinations to enable its attachment to specific computers and typewriter models. Whether the computer calls for an RS-232C, an IEEE-488 or a Centronics parallel interface, there is a Supercord to meet the need. Price is $395.

There is also a Supercord II that contains a 4K memory. This enables the computer to receive data input while the typewriter is typing the previously entered data.

Check Reader Service number 430.

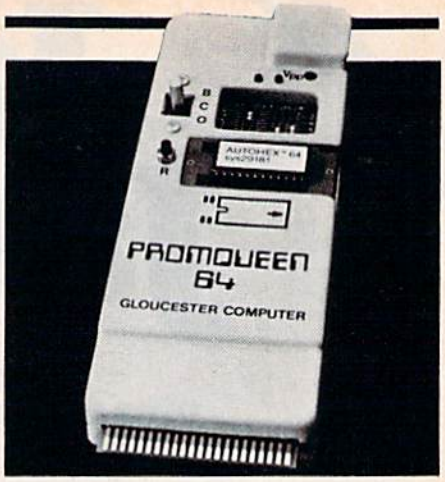
Turn Your C-64 Into an Apple?

Mimic Systems' AP Modular Pak, from Pioneer Software, Inc. (#217-620 View Street, Victoria, BC, Canada V8W 1J6), is a hardware addition for your Commodore 64 that allows you to take advantage of the vast pool of Apple II-compatible peripherals and software.

With the AP Modular Pak, any program designed for the Apple II will now run on the C-64. All Apple II-compatible hardware peripherals function the same as they would connected to an Apple II. This means the various processors available for the Apple II can now be used with your C-64.

The AP Modular Pak has three components: the AP Bus, which contains eight standard Apple II peripheral slots and four C-64 expansion slots; the AP "CPU" Card, the heart of the system, which plugs into its own slot on the AP Bus and handles all Apple II to C-64 conversion; and the AP DOS Card, a peripheral card for the Commodore 1541 disk drive that transforms the 1541 into an inexpensive Apple II-compatible drive. It costs under $500.

Check Reader Service number 425.



Promqueen/64

The Promqueen/64 microprocessor development cartridge, designed for the Commodore 64, is a more sophisticated version of the Promqueen cartridge introduced earlier for the VIC-20.

The Promqueen/64 is a microprocessor development system for high-speed, efficient EPROM-resident machine language programs. It is intended for use by sophisticated designers and computer science educators as well as hobbyists.

The Promqueen/64 features universal editing software—Autohex/64—and uses the C-64 for keyboard input and CRT display. With this system, EPROM chips containing the final programs can be made for any 8-bit microcomputer.

Applications range from sophisticated industrial process control to computer-controlled toys. Music synthesizers can be reprogrammed, robot controls can be developed, instruments can be recalibrated—any computer-controlled device can be programmed or reprogrammed. All capabilities of the original Promqueen programmer—with the exception of the Mimic mode—have been retained.

The Autohex/64 software provides quick block transfer, remapping, transfer of bytes from and to marked locations, instant jumps to addresses specified in the commands (with optional return to the address jumped from), and global search for opcodes that are likely to need remapping when blocks are transferred.

The Promqueen/64, complete with 60-page instruction manual and EPROM firmware for all operations, is available for $299 from Gloucester Computer, Inc., 1 Blackburn Center, Gloucester, MA 01930.

Check Reader Service number 434.

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File Organizer Creates Data Base storage system. For mailing lists, club rosters, check books, etc. $29.95

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Clubs

Southern Oregon

The Southern Oregon VIC-20/C-64 User's Group was started by Jim Powell in August of 1983. Meetings are to be held twice a month, and a newsletter will be sent out to members.

If you are devoted to learning how to put the VIC-20 and C-64 to good use, contact Mr. Powell at 3600 Madrona Lane, Medford, Oregon 97501, (503-779-7631). He'd like to hear your ideas.

Peoria Area

PAPUG (Peoria Area Pet User's Group) is composed of about 50% C-64 members, 35% VIC-20 owners and 15% PET owners. Meetings, which are normally organized around a software or applications theme, are held on the second Friday of each month. A disk and tape of public-domain software is made available each month.

Contact Max Taylor, President, 800 SW Jefferson St., Peoria, IL 61605 (309-673-6635), or Fran Donovan, Vice President/Librarian, same address, (309-674-5998).

Montgomery County, MD

Persons interested in joining The Montgomery County Commodore Computer Society should contact Meryle B. Pounds (301-946-1564) or Dave Menaker (301-770-6778) at the club's address: PO Box 6444, Silver Spring, MD 20906.

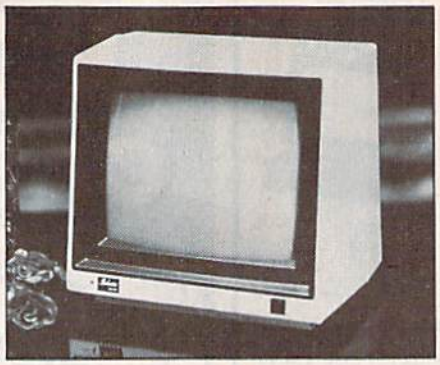
Aberdeen, MD

The Compucats, a user's group sponsored by the Software Development Company, is open to any computer owner, or prospective owner.

The club offers members a wide range of services, including an extensive library of Commodore computer software and a large selection of Commodore literature. The Compucats also sponsor special activities such as computer shows and programming contests.

The club holds monthly meetings at 7 p.m. on the second Tuesday of each month at the Aberdeen Branch Library.

All inquiries concerning the club should be addressed to the secretary of the group, Betty Jane Schueler, Software Development Company, 680 West Bel Air Ave., Aberdeen, MD 21002, (301-272-4195).



Sakata's Color Monitor

Sakata USA Corp. (651 Bonnie Lane, Elk Grove Village, IL 60007) has introduced the SC-100 CRT Composite Color Display Monitor. The SC-100 monitor is compatible with the Commodore 64 and the VIC-20.

The SC-100 produces a minimum of eight colors and can display up to 1000 characters.

Controls for the picture include: phone pin jack, sound, contrast, power switch, vertical hold, color, tint, brightness and more.

The SC-100 is made out of a beige polystyrene material. It has a 13" screen and weighs over 30 lbs. It costs $329.

Check Reader Service number 431.

Do-It-Yourself Programming

The Lynn Video Instruction Series (Lynn Computer Service, 6831 W. 157th St., Tinley Park, IL 60477) is a series of videotapes designed to teach you how to use your Commodore 64 or VIC-20.

Each videotape is designed as an individualized learning aid, teaching you Basic programming in a step-by-step manner. There are two instruction tapes in the Basic programming series for each computer.

The first tape in the series instructs in the use of the keyboard graphics and introduces the Commodore Basic programming language. The second tape teaches programming techniques for use with the Commodore 1541 disk drive.

All tapes are in color and contain over 1 hr., 45 min., of instruction. Each tape includes sample programs.

The tapes cost $49.95 each on VHS or BETA format video cassette.

Check Reader Service number 422.

Touch-Sensitive Pad

PowerPad (Chalk Board, Inc., 3772 Pleasantdale Road, Atlanta, GA 30340) is a touch-sensitive input device for the VIC-20 and the Commodore 64 that replaces the keyboard as a means of accessing the computer. It was created in conjunction with Chalk Board's Leonardo's Library as an integrated system.

PowerPad has a 12" × 12" active surface and multi-contact compatibility—it is able to respond to more than one point of contact at a time.

PowerPad allows you to redefine the surface of the pad at will, so you can do anything with the given area—such as draw pictures, play games and learn music.

PowerPad connects to the computer through a serial interface, usually through the game port. In addition to use with the firm's proprietary software, PowerPad can run programs written by the user in Basic.

The PowerPad comes housed in an off-white polystyrene case which measures 17" × 20" × 1.5". It costs $99.95.

Check Reader Service number 408.

Expansion Board For Your Commodore 64

For those who want to expand their C-64, Elcomp Publishing, Inc. (53 Redrock Lane, Pomona, CA 91766), has released a new prototyping board.

The board plugs right into the expansion board on the backside of your C-64. All connectors can be accessed, and a special layer for ground is provided throughout the board.

The board is drilled and through-contacted for easy soldering and construction of your specific application. It costs $9.95.

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A total reference work on the Commodore 64, Inside the Commodore 64 gives you inside information on the inside of the machine: its graphics, its music synthesizer, its built-in software and the techniques for taking advantage of the many powerful features of this computer. A complete memory map is provided with information on how to call the internal programs from your own. Written as a programmer's guide with a machine language programmer's perspective, it will become your primary reference guide. If you are still learning you will find it your best teacher.

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comes free with Develop-64 ($49.95).

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Software RUNdown

Compiled by Shawn Laflamme

Magic Desk

Commodore International (1200 Wilson Drive, West Chester, PA 19380) has announced the Magic Desk software series for the C-64.

Magic Desk depicts a full color desk on your computer screen. There's a typewriter, index file, telephone, calculator and financial journal on the desk and a wastebasket under it. There's also an artist's easel and a vertical file cabinet with a digital clock on top of it.

To use any feature of the Magic Desk, you use a joystick, trackball or mouse to move a pointing finger to one of the objects on the screen. Magic Desk uses no language instructions. All instructions and menus are pictorial, using symbols that Commodore calls "metaphors."

An example of such a metaphor is the picture of a scrolled sheet of paper that appears at the bottom of the screen when you're using the typewriter. After you've typed a page, you can move the pointing finger to the scrolled sheet, pick it up and move it to the file cabinet. All of the pictorial files on the screen are linked to a Commodore disk drive, which stores the information. You can print out the information on a Commodore printer or printer/plotter.

The first package (a plug-in cartridge) in the series is called Magic Desk I—Type and File—which activates the typewriter, index file and related editing and filing features of the animated desk.

The C-64's sprite graphics allow the programmer to redefine the objects on the desk. For example, an educational program might put alphabet blocks on the desk, or a musical program might put a guitar there. The menu items can be changed in the same way. The estimated price is $100 per cartridge.

Check Reader Service number 410.

Leonardo's Library

Chalk Board, Inc. (3772 Pleasantdale Road, Atlanta, GA 30340), has released Leonardo's Library, a set of learning/discovery software packages.

The library has been designed to contain more than 30 software packages that span six subject areas—visual arts, music, mathematics, science, language arts and social studies—and five content levels.

Along with Chalk Board's PowerPad touch-sensitive input device, the Library becomes part of an integrated peripheral software system.

With PowerPad and Leonardo's Library, your VIC-20 or C-64 becomes an artist's canvas, a golf course, a musical instrument or a geometry puzzle, depending on the program being used.

The first packages in the Library series include Leo's 'Lectric Paintbrush and Micro Maestro. Individual packages in Leonardo's Library are available on cartridge or disk and are priced from $24.95 to $49.95.

Check Reader Service number 400.

Record Your Securities Transactions

Stock Brief-64 is a disk-based filing system for recording securities transactions.

It has seven commands: buy, sell, valuate, edit, list, directory and quit. It has the ability to abort anywhere in a transaction. Multiple files are supported with disk directory.

The valuate command allows current stock prices to be entered to see "results if" shares were to be sold. This system supports all printers interfaced through the 64 serial bus. It costs $50. Mystic Software, PO Box 25, Mystic, CT 06355.

Check Reader Service number 403.

QuickFinger

QuickFinger is an educational touch-typing game that teaches the locations of keys on a typewriter/computer keyboard. It is comprised of three independent games: AlphaZap, Link the Letters and Keyboard Pacer. QuickFinger is compatible with the Commodore 64 and is available on disk and cassette.

AlphaZap is designed to help hapless Alfie Zap reach home through a bombardment of letters dropping from the sky. In order to stop him from being "alphazapped," the user must type the appropriate letter on the keyboard. The initial levels (there are 16) make use of the "home keys" (a,s,d,f,j,k,l,;). At higher levels, the letters fall faster and the entire keyboard is used. The user learns that the best way to hit the letters in proper sequence is by using the same fingering used by touch-typists.

QuickFinger's other two games are also designed to develop keyboard skills. Link the Letters asks users to find three- and four-letter words concealed in a maze; it can be used as a vocabulary-building tool for children.

Keyboard Pacer simulates a typewriter keyboard and challenges users to race the clock in attacking the proper key as it flashes on the screen. Once again, the earlier levels are based on the home keys. Top- and bottom-row keys are used as the typist builds speed.

QuickFinger costs $39.95 and is manufactured by Quick Brown Fox, 548 Broadway, Suite 4F, New York, NY 10012.

Check Reader Service number 407.

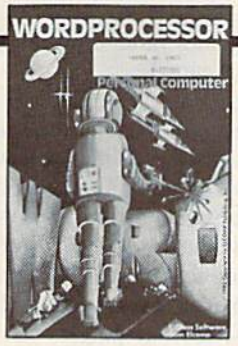
All Aboard...

Logo Locomotion, for the Commodore 64, contains six games that teach the graphics commands of the Logo language. Color X-Y and polar grids are displayed to assist students in developing an aptitude for estimating distances (turtle steps) and heading angles (degrees). Extensive error checking and feedback provide an environment in which students can learn by correcting their own mistakes.

It is appropriate for grades 2-12, teacher inservices and classes with limited computer access. Features include scorekeeping, color, sound, onscreen instructions and a 22-page manual.

It requires Terrapin or Krell Logo and is available for $23.95 from Compulit, Computer Literacy Associates, PO Box 254, Sherborn, MA 01770.

Check Reader Service number 414.



C-64 Word Processor

Bliztext, a word processor for the Commodore 64, consists of three parts: the editor, the formatter and a terminal program. It is fully screen-oriented, with horizontal and vertical scrolling and up to 255 characters/line.

Bliztext has left and right margin justification and a centering mode. There are about 30 commands in the editor and 20 formatting commands. All Commodore cassette and disk I/O commands are supported.

It features an upper/lowercase character set that can be run on all printers (RS 232, IEEE, IEC). The printer control characters can be inserted into the text for underlining, bold overprint, etc.

The built-in terminal mode lets you use your computer as a terminal for receiving and sending electronic mail (upload and download).

Available on disk or cassette, Bliztext comes in a plastic binder with a 46-page manual. It costs $89. Elcomp Publishing, Inc., 53 Redrock Lane, Pomona, CA 91766.

Check Reader Service number 413.

Checkbook Manager

MicroSpec, Inc. (PO Box 863085, Plano, TX 75086), has introduced the Checkbook Manager for the Commodore 64 and the VIC-20.

The program helps manage financial requirements for personal or business applications. The program for the C-64 handles up to 20 expense categories and 20 income categories defined by the user. The VIC-20 program handles 15 expense and 15 income categories. The Checkbook Manager tracks all outstanding checks, reconciles monthly financial statements and tracks expenses on a quarterly and year-to-date basis.

A special feature of the C-64 program is its graphics capability. It generates a bar graph that shows budget guidelines against actual expenses to help control cash outlays.

The cost of the program for the C-64 is $69.95, and the VIC-20 program is $49.95.

Check Reader Service number 428.

Grade and Attendance Package for Teachers

GradeCalc is a grade and attendance management package designed to eliminate many of the time-consuming tasks of record keeping. Grade filing and reporting are set up in a flexible manner to accommodate any teacher's existing gradebook format.

With GradeCalc the teacher has on file all the raw grades and assignment information. This file can then average grades using a variety of methods, ranging from percentage scores to symbolic (letter) grades. In addition to averaging, a number of reports can be generated. For example, the teacher can obtain a cumulative listing of missing assignments. Other reports include grade totals, averages, grade book listings and assignment summaries.

GradeCalc also maintains attendance records from which the teacher can recover a variety of reports, including cumulative totals of all attendance records and problem reports based on excessive absences or other problems.

The GradeCalc package is available on disk for the Commodore 64 for $29.95. It is manufactured by Tamarack Software, Inc., Water St., Darby, MT 59829.

Check Reader Service number 406.

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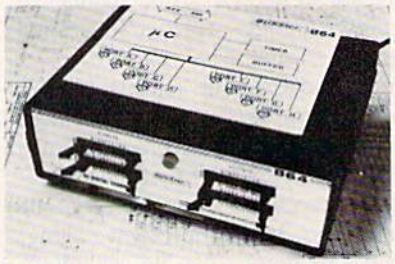

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For C-64 Software, Don't Ask

Don't Ask Computer Software, Inc. (2265 Westwood Blvd., Suite B-150, Los Angeles, CA 90064), has released three new software products for the Commodore 64.

The Software Automatic Mouth (S.A.M.) is an all-software speech synthesizer. It requires no hardware; just the standard computer, disk drive and television or audio monitor. It's a disk program that gives the C-64 the power to speak any words or sentences the user types.

S.A.M. allows programmers to create talking programs, such as learning tools for young children, business software and adventure games with talking characters. The price is $59.95.

The Wordrace gamepack for the C-64 features Wordrace, a vocabulary game, in addition to Claim to Fame (a history game) and Sports Derby (a sports fact game).

In Wordrace, players are given a word and six possible definitions; a counter ticks the points away while they decide which definition to choose. A correct answer earns players all the points left on the counter, but a wrong answer deducts points from their score, so players need to use care and strategy. From one to four players can compete in Wordrace and learn new words as they play.

Claim to Fame challenges players to recognize famous people and match them with their claims to fame. In Sports Derby, the object is to match famous and not-so-famous athletes with what they achieved.

The Wordrace gamepack is available on disk or cassette and costs $34.95.

Chatterbee is a talking game that teaches spelling to school-aged children. During play a colorful bee appears on the screen, and good spelling is rewarded with points, smiles from the bee, spoken praise, music and advancement to higher levels of play.

Chatterbee tells the player how to spell any word he cannot get in three tries and retests him later on the words he missed. The 2500 spelling words and sentences in Chatterbee's database fall into 25 difficulty levels that are keyed to accepted educational standards for grades 1–12.

Chatterbee requires a disk drive. It costs $49.95.

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Write Programs Without Programming Knowledge

Home File Writer software allows owners of the Commodore 64 to write unique programs for many uses in the home without knowledge of computer programming.

The user can write a unique program by typing the screen layout form and the calculations onto the computer's screen in plain English. Home File Writer translates this and automatically writes the "code," which will do the work in the computer.

The program has many potential uses, such as maintaining inventories of household belongings; mailing lists; tax information; recipe files; records of credit cards; medical and health records; inventories of stamp, coin and other collections; check balancing; and register programs.

Home File Writer is available on disk for $69.95 from Dynatech MicroSoftware, Inc., 7847 N. Caldwell Ave., Niles, IL 60648.

Check Reader Service number 412.

ZIP It, Ham It Up On the C-64

RAK Electronics (PO Box 1585, Orange Park, FL 32067) has announced two new software products for Commodore users.

Commodore 64 Mail is a multi-purpose mailing list management system. Mail will allow you to construct, sort, maintain and print out a mailing list of over 300 addresses. Subfiles created from the main file allow growth beyond the 300 address limit.

An optional heading allows you to keep track of member numbers, expiration dates, scores, etc. Mail is compatible with tape or disk. It is available on cassette for $14.95 or disk for $17.95.

SWL RTTY/Morse converts your VIC-20 or C-64 into a low-cost RTTY and Morse decoding and display terminal. It allows you to receive 45 to 100 baud Baudot RTTY and 5 to 30 wpm Morse code. It requires a TTL-compatible terminal unit.

The package includes software on cassette, a special user port connector and complete instructions. It costs $19.95.

Check Reader Service number 404.

Two New Programs From Arfon Micro

Arfon Micro (111 Rena Drive, Lafayette, LA 70503) has released two new programs for Commodore users: MicroBase and Microterm 64.

MicroBase is a user-configurable database and mailing label/report generator for the VIC-20 and the C-64. It allows up to 12 fields per record, 80 characters per field and 176 characters per record. You may sort by any field, using any of seven different alpha, numeric, or character match parameters. The program is available on cassette for $29.95 or disk for $34.95.

Microterm 64 is a terminal communications program for the C-64. It allows file transfer under ASCII and Commodore protocols. You may download incoming files to disk, tape or printer, and upload and transmit files from tape or disk. The program enables you to menu select the baud rate, word length, stop bits, parity, duplex/half duplex and other parameters. It is available on cassette for $39.95 or disk for $44.95.

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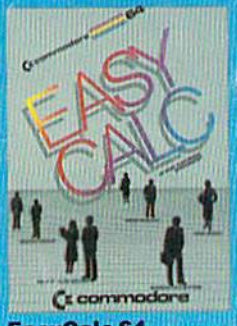

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